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Cover painting by Dan Todd
April 1965

Buying a used car? A few easy tests can help separate the dogs from the cream puffs. Page 96.

Drilling wood is a cinch—if you use the right bit. Here are the simple ABCs. Page 146.

Tired of pushing? PS gives you the facts you need to buy a riding mower. Plus giant spec chart. Page 172.

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PUBLISHED MONTHLY by Popular Science Publishing Co., Inc., 355 Lexington Ave., New York, N. Y. 10017

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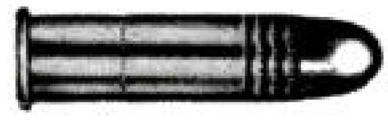

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I figured maybe I.C.S. could help me. I clipped out the coupon from an I.C.S. ad and mailed it in. The free career kit I received a few days later convinced me to sign up for a course.

Things began to happen after that. The instruction was practical, down to earth. It seemed what I learned the night before I was able to apply on the job the next morning.

Word got around I was taking an I.C.S. Course. My boss learned of it and three months later I got a raise. Six more months and I got another. Now I'm looking forward to a promotion.

Once in a while I remember the time the boss said I didn't have what it takes. Makes me smile now. But still I thank my lucky stars for I.C.S.

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PS readers talk back

Want to get something off your chest? Write "Readers Talk Back," Popular Science, 355 Lexington Ave., New York, N.Y. 10017.

A Tip of the Hat

Our hat's off to you for "How the Armed Forces Create Careers for Specialists" [Feb.]. I was very impressed with the article and its plain facts. I'd like permission to use it as one of our recruiting aids aimed toward young high-school students. I feel the article will also aid in putting the idea across to former service men to affiliate with their various Reserve programs, too.

J. C. Collins, Recruiter-in-charge
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Permission granted.

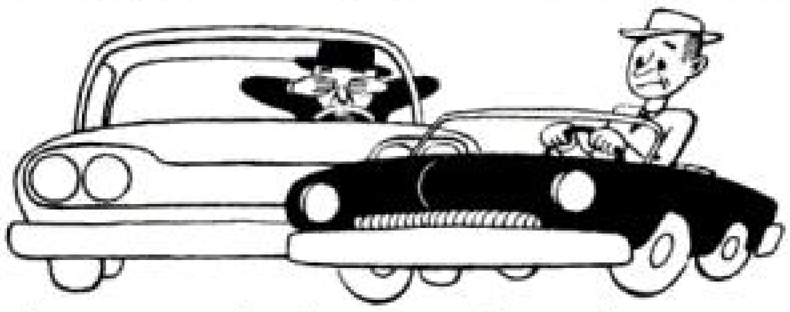
Danger Is as Danger Does

I try not to fall into the morass of stupidity that Devon Francis does such a good job of representing ["More Danger in a Small Car?" Feb.], but I do wonder how much allowance is made for exposure in these studies.

A man driving daily into a city during rush hour is more likely to have an accident than his wife driving—say, twice a week—the same route at 10 a.m. to go shopping. The same road-exposure relationship may apply to car size: I often count cars passing in the opposite direction and find VWs average five percent, yet registration statistics show only three percent.

Michael Firth, Ames, Iowa.

. . . One retort to Devon Francis' remark that "bugs" are more maneuverable and stay out of the way: What they do to other drivers while they're getting out of the way causes



accidents in which they, themselves, are not involved. I drive a Ford Model A. No Cadillac ever cut me off, but plenty of VWs have. I hope VW drivers realize I have mechanical brakes and keep out of the way. If the Ford hits one, look out!

H. V. Pullen, Westfield, N.J.

. . . In an accident, a person at the point of impact in a small car has no room to move to avoid jagged metal, as he could in a big car.

Gene Zebroski, Newark, Del.

. . . In a rollover in a small car, all five of us crawled out to see the wheels—where the roof should be—still turning. Wedged together, we had turned together like sardines in a can. Total injuries: one black eye.

H. S. McCormick, Houston.

. . . I disagree with the claim that small cars are safer because they're slower. A government report *(Accidents on Main Rural Highways Related to Speed, Driver, and Vehicle)* states that drivers of low-power cars have higher accident-involvement rates—regardless of other variables.

John Tuccio, Ansonia, Conn.

Built from Scratch

I designed my own two-speed tape recorder. It has a good frequency response and can play up to 2,400-foot spools. No parts were purchased in kit form.

The recorder has two advantages: Tape wear is minor because the coated side passes over one guide only. A signal light reads "Record" or "Play" according to the position of the playback switch.

V. H. Vaidya, Bhavnagar, India.

He Got the Sugar

"How to Sweeten a Lemon" [Jan.] agrees with my experience. The automatic transmission went bad when my '61 Ford Deluxe station wagon had 34,000 miles on it. I wrote Customer Relations and got a prompt reply routing me to their local branch. I didn't get far with them, so wrote the main office again, and a new transmission was installed for a very low price—the factory paying most of it. It turned out the transmission housing was too light and the casting inside had cracked.

My experience proves that Detroit wants to keep customers happy—even if the car is out of warranty and over three years old.

Gerald Cole, Addison, Ill.

Call for Smokey Yunick

I disagree with Smokey when he says [Feb.] that a defective pressure cap might cause overheating in a Pontiac. Pressure in the cooling system controls the temperature point at which water boils, not temperature of the engine. At sea level (as at New York City), the engine will operate at the same temperature, pressur-

[continued on page 12]

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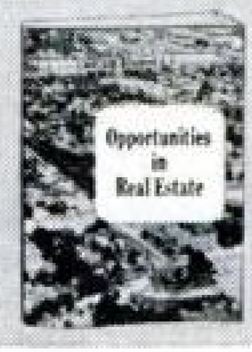

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f.o.b. factory. Wt. 25 lbs.

Includes completely assembled cast iron and steel 8" tilt arbor power saw with ground cast iron table . . . less blade. If desired, RIP FENCE for easier work alignment, $3.50 additional

DOES WORK OF $75 BENCH SAW as is. Converts easily to equal any $300 floor model cabinet units! Crosscuts, rips, mitres, cuts compound angles, dadoes, makes coves and mouldings.

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Use as portable bench saw as received (inset photo) . . . or transform easily and inexpensively into floor model (as shown) guar. to do work of floor models costing $300. FREE plans . . . sheet of ¾" plywood and 3-4 hours are all you'll need. Use your AMCO saw for cutting. Plans provide 27" x 24" work surface, 33" height, pullout sawdust bin, tool storage compartment.

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• Locks securely at any angle to 50 raises, lowers 0"-2¼" • Patented ti mechanism, accurate etched scale Patented motor mount takes std. h.p. or larger motor, keeps belt tigh assures perfect alignment at any angle transmits full power • Takes std. blade saw insert removes to take dadoe heads cutters, etc. (not incl.) • Accurate mit gauge assembly • Ground spindle • En closed steel base • "Compo" bearing • Accessories available at factory price • RIP FENCE, if desired for easier wor alignment: Std. size (for bench saw $3.50; larger fence (for cabinet base as ill'd.) $4.50.

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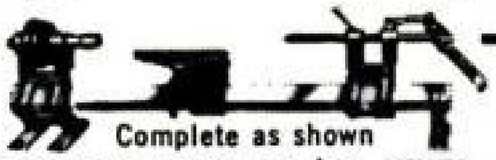
Optional Faceplate for turning bowls, trays, lamp bases, rosettes, etc. $2.50



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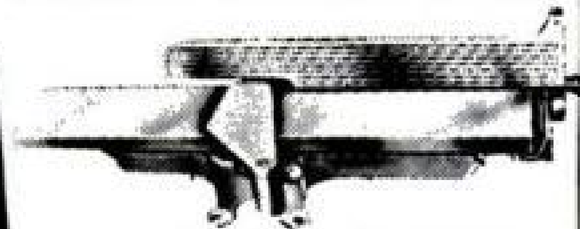

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$14.95

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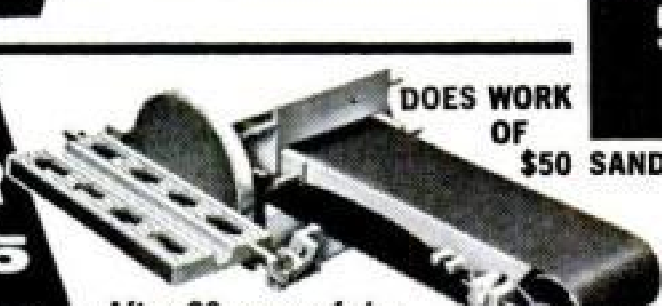
Optional Disc Sander incl. disc, bracket, ground cast table (tilts 0-45°): $7.95 add'l. Mitre gauge: $1.95 add'l.



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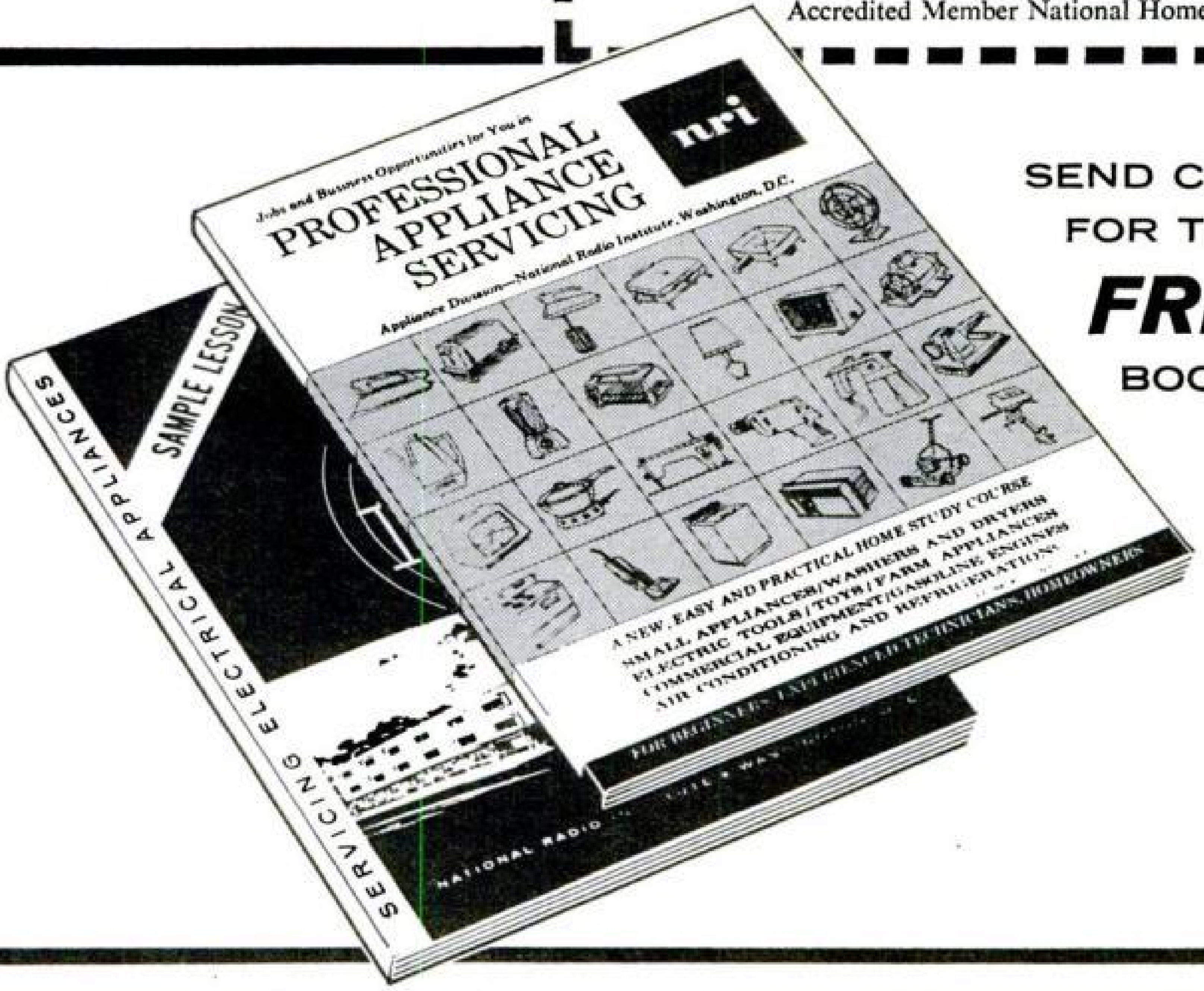

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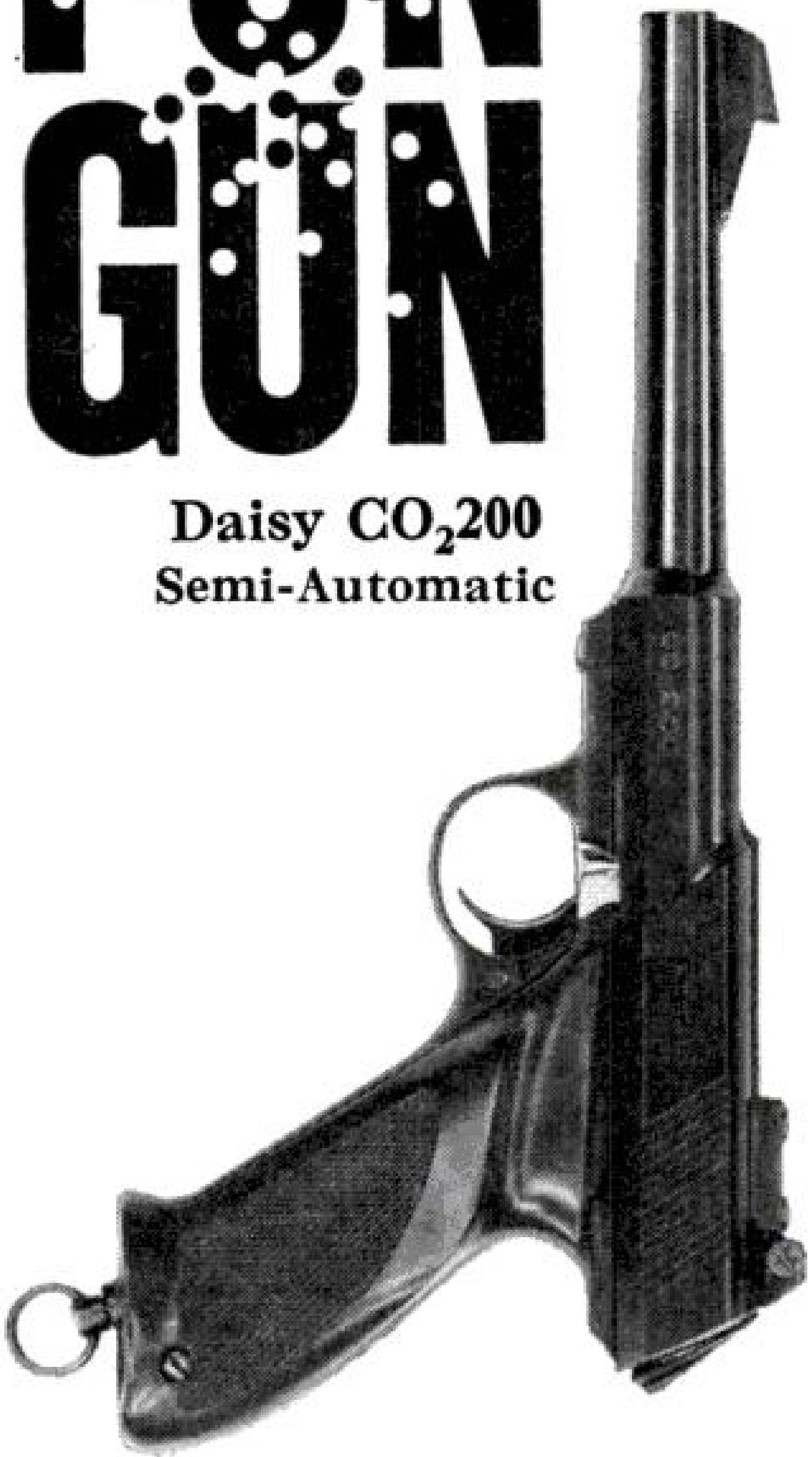

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[Continued from page 6]

ized or not. I'm operating my car unpressurized because the 14-pound cap causes the tank seams to open, and I have no trouble.

The purpose of the pressure cap is to allow the engine to operate at high temperatures without boiling *at high altitudes.*

ONUS M. COMER, Novato, Calif.

. . . We noted Smokey's comments [Jan.] on preventing fires in racing—particularly the need for fireproof clothing. We have developed a new finish for cotton and rayon that can now give these fabrics a fire retardancy that will not wear out or launder out.

D. L. EDWARDS
Hooker Chemical Corp., Niagara Falls.

He Has a Question . . .

Whenever anything has to be done around the house or on the car, I consult PS, but as I keep hoarding issues, it becomes increasingly difficult to locate back articles. Why don't you print a yearly index?

I've just finished building the Styrofoam model airplane described back in March, 1963. It flies like a bird.

BARRY JONES, Brooklyn, N.Y.

Yearly indexes were sold for some years, but interest in them was not high enough to warrant continuance.

. . . He's Got the Answer

Other readers may be interested in how I locate back articles in jig time: As each new issue of PS arrives, I clip the contents pages from the previous one and file it in a loose-leaf book. By underlining with red any articles of special future interest, I not only can find things easily but I can flip through the book when I'm searching for a weekend project.

L. T. NELSON, Newark, N.J.

Greatest Dam Thing Ever

Just read about the spectacular Manicouagan-Outardes dam project ["Caging a River to Build a Skyscraper Dam," Feb.] in Quebec. It's soon to be overshadowed by the greatest one of all, Rampart Canyon Dam in Alaska. This 500-foot concrete structure will impound the Yukon River 100 miles northwest of Fairbanks, forming a reservoir 10 percent larger than Lake Erie. A five-million-kilowatt power plant will be the largest anywhere.

In recent years, the Russians have been building dams that produce more electricity than any of ours. Most of them are in Siberia and seen by few. Rampart Canyon Dam, built by the Army Corps of Engineers, will outproduce any Soviet dam, existing or under construction—concrete proof (all nine million cubic yards of it) that the world's leading dam builders are American.

A. J. GOLDEN, Bremerton, Wash.

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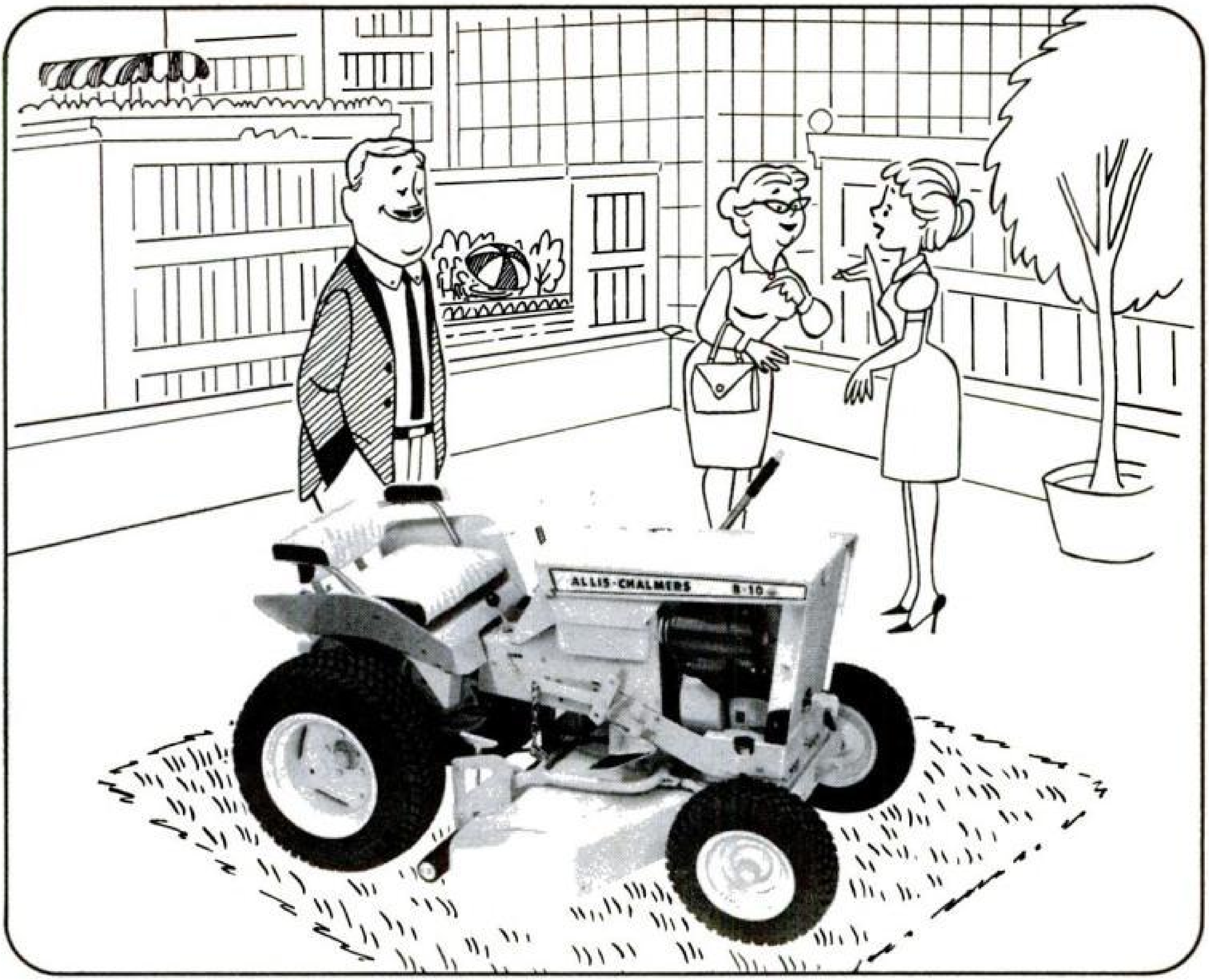

Oh, I don't know...he just wanted it

Judson is a real gentleman. Hunts with Italian shotguns, collects jade, has his tweeds made in England. Nothing but the best for Judson.

While weekending in the country, he observed a B-10 tractor at work on the lawn. Even took a turn on it himself.

Right away he exclaimed, "this is the only *proper* way for a real gentleman to care for his lawn in town." So he bought a B-10 . . . even a snow clearing attachment for next winter.

But don't worry about Judson. He owns a factory. He could find plenty of jobs down there for his B-10, if he wanted to. But chances are, he'll buy another one.

You know, the B-10 is from Allis-Chalmers, the tractor people who make the big ones.

You too can live like a gentleman and be practical . . . especially if you have a yard.

I may just want one too. Send me the booklet that tells all about the B-10 and attachments.

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______ **"Grounds for Pride"** for office use

______ I'd also like my **dealer's name**

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'Say, Smokey–'

A clinic on cars by America's most famous mechanic

EACH month in POPULAR SCIENCE, Smokey Yunick will answer questions on automobiles–family cars, high-performance jobs, hot rods, and racing cars–selected from those sent in by readers. Got a problem? Ask Smokey about it. You'll find the address at the end of the column.

"Why does my Rambler refuse to start in cold, damp weather, when just a touch of the starter sets it to purring sweetly in warm, dry weather?"—Harry C. Most, Baltimore.

The starter has more work to do turning over a cold engine–and less to do it with. Check the battery, cables, and connections. If they're okay, check the ignition wiring carefully throughout for possible leaks. Also check the distributor for shorts. Be sure that the automatic choke is functioning right. Don't use too heavy an oil in the crankcase. With these precautions your engine should start up and purr like a kitten in any weather.

"In my 1964 GTO with tri-power carb, I have installed a '62-421 McKellar #10 cam and solid Chevy lifters. What are the proper valve lash settings for this setup? Also, what carb jetting would you suggest for getting the best performance?"—Smiley Hudson, Waco, Tex.

The lash should be .012 and .018 cold, or .010 and .015 hot. Hot checks should be made after the engine has run for a while. Check them frequently–they change. For normal driving, the jets should be .073 for the end carbs and .070 for the center. If you have the big, super-racing heads, use .077 on the ends and .070 in the center. If the car is used for dragging, run .073 on all three of the carburetors.

"I recently had new brakes installed on my '59 Pontiac Catalina. Now when I step on them they pull right, then left, and so on until stopped. The wheels have been lined up and balanced, and still the trouble continues."—Chester H. Hodge, Sterling, Ill.

Check your brake hoses and wheel cylinders. Be sure the wheel cylinders have plenty of clearance–even more than specified. If that doesn't remedy the trouble, check for a weak front spring. That could be the cause of your problem.

"Two '53 engines have blown so far in my '53 Chevy that I use for stock racing. Even though I check them for good condition before each race, my rods and bearings break. There is good oil pressure each time before the engine blows. How can I keep an engine together?"—Carl Behan, Troy, N. Y.

In '53 manufacturers weren't building engines for extreme load conditions, as they are doing today. Install stronger rods by substituting from a later-model engine that has rods to fit, or you can beef up your present ones by a process we call plating.

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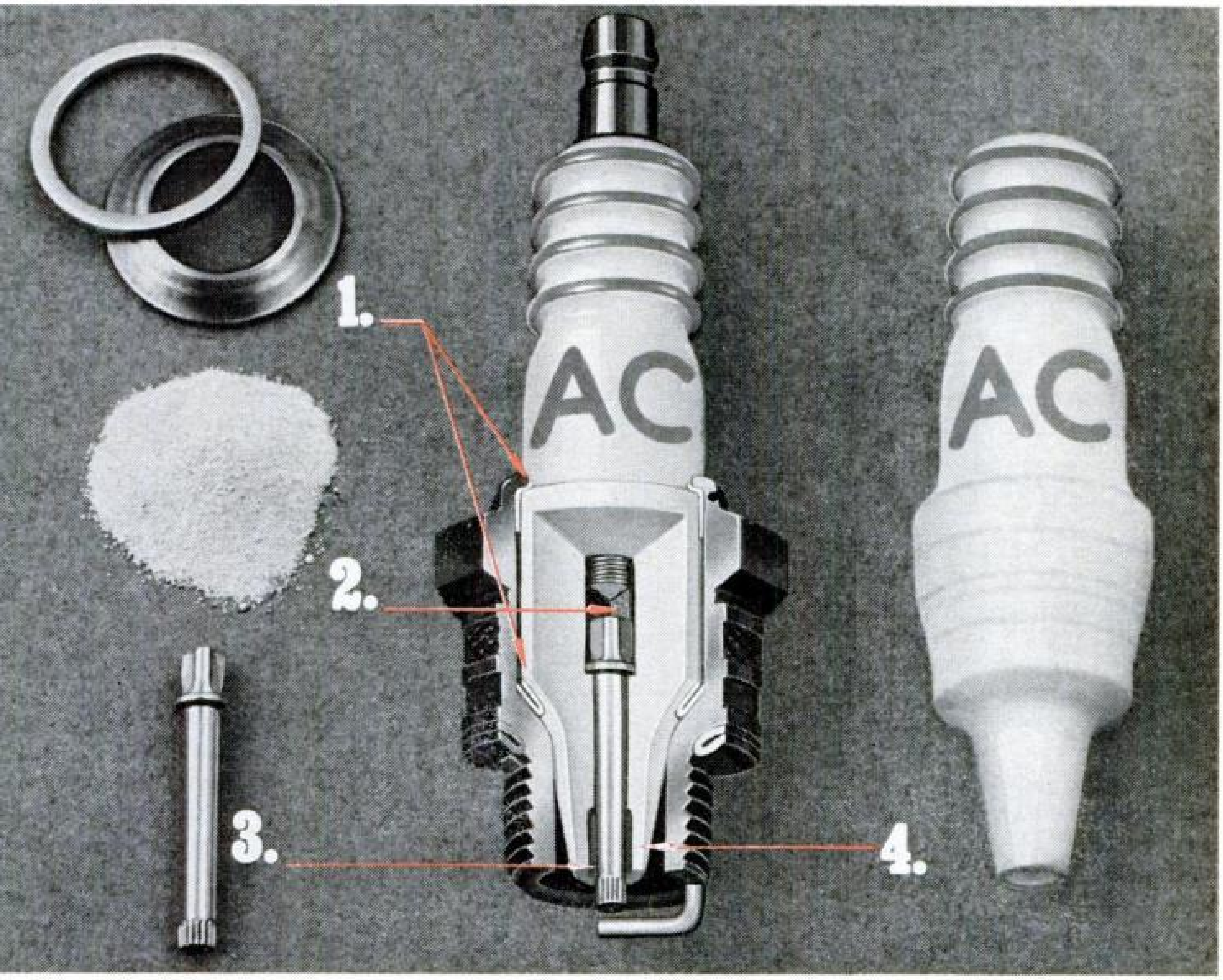
Only AC Spark Plugs have all these built-in power-boosting features



. **Extruded Internal Gasket** provides gas-tight sealing between insulator and hell, assures peak engine compression under severe operating conditions. **. Fused Metal-Glass Seal** assures maximum electrical conductivity, and at the ame time prevents combustion gas leakage around the center electrode. Guards gainst spark plug overheating, pre-ignition and possible engine damage. **3. Knurl-d Center Electrode** provides greater sparking capability to ignite combustion ases more easily, delivers maximum power, maximum fuel economy. **4. Self-leaning Hot Tip Insulator** heats faster to help prevent fouling, cools faster to elp prevent pre-ignition. Helps assure top economy with maximum engine per-ormance at all speeds. These four important AC design-features combine to help roduce continuing maximum energy out of the fuel you buy; boost power, per-ormance, mileage. Put all these spark plug features to work for you. Tune up for ower with AC Fire-Ring Spark Plugs—best for all cars.

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In this operation, metal plates are cut to fit in the I-beam web of the rods, and welded in. With the heat-treating necessary, this fix takes the skill of an expert.

"Somehow, I'm getting oil in the radiator of my '59 Plymouth 6. The radiator has been flushed and drained, the head removed, and a new gasket installed. There is no crack in any cylinder bore, or signs on the head of undue pressure. I'm stumped. Have you any ideas?"—Steve Sopko, Ironwood, Mich.

There could be one or more cracks or pinholes in an oil gallery that open up under heat. Oil pressure being greater than the water pressure, the oil would then get into the cooling system. Also, I'd suggest that you check that head gasket, even though it's a new one. Examine its surfaces and the head for poor contact. Are you sure you have the correct gasket, so that no openings are left uncovered to encourage oil leaks?

"The engine on my 1963 Tempest 326 with a two-barrel carb has more than 25,000 miles on it, and it won't turn over 4,600 r.p.m., no matter what I do. It doesn't falter, sputter, or surge. We've tried removing the fuel filter, using larger jets, colder plugs, blocking off the crankcase breather, and adjusting the carb float higher. Can you help me out?"—William A. Copthorne Jr., Tampa, Fla.

Put in a new set of Pontiac high-performance valve springs, make sure the lifters are okay and set up to spec, and I'll bet your tiger will growl again.

"My '53 Packard-8 Clipper never used oil between 1,000-mile changes for 35,000 miles. Then a mechanic did a carbon-and-valve job for me, replacing two valves. Now I have to add two quarts every 150 miles. What's wrong?"—James La Penna, NYC.

There's something wrong—but not in the seating of the valves, certainly. When you increase compression in an engine with a good valve job, it often uncovers other weaknesses, usually in the valve guides or rings. First, rule out the less expensive oil robbers—obvious oil leaks in pan or gaskets, clogged oil-sump vents, or possibly a late-running camshaft. Next, check for excessive

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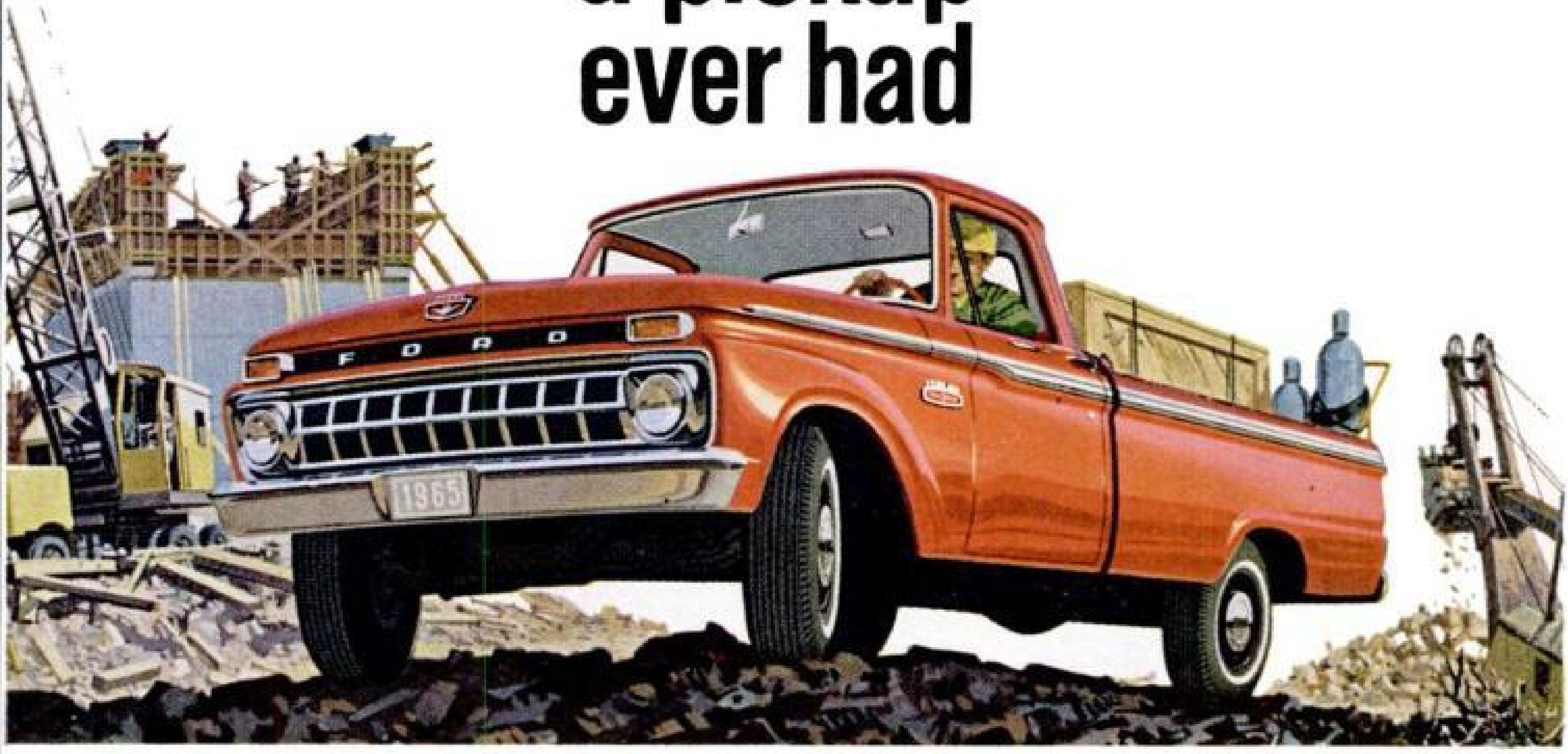
'65 FORD PICKUPS

WITH

• Front wheels operate independently, each on its own axle • Axles are forged I-beams—as used in big-truck axles • Forged radius rods secure axles solidly to frame siderails to hold wheel alignment • Axles and radius rods pivot in no-lube bushings

Sturdiest front-end a pickup ever had



Two front axles! That's the big difference in Ford's spectacular new Twin-I-Beam suspension that produces a very untrucklike riding smoothness. What's more, forged I-beam radius rods anchor wheel alignment to cut front-end adjustments—extend tire life—reduce maintenance needs. Result: the sturdiest independent suspension you've ever seen, the smoothest pickup ride yet. Try it at your Ford dealer's.

THREE ALL-NEW ENGINES! Now standard: brand-new 240 cu. in. economy Six! Optional: new 300 cu. in. Big Six, powerful new 352 cu. in. V-8!

Smoothest ride you've ever tried!

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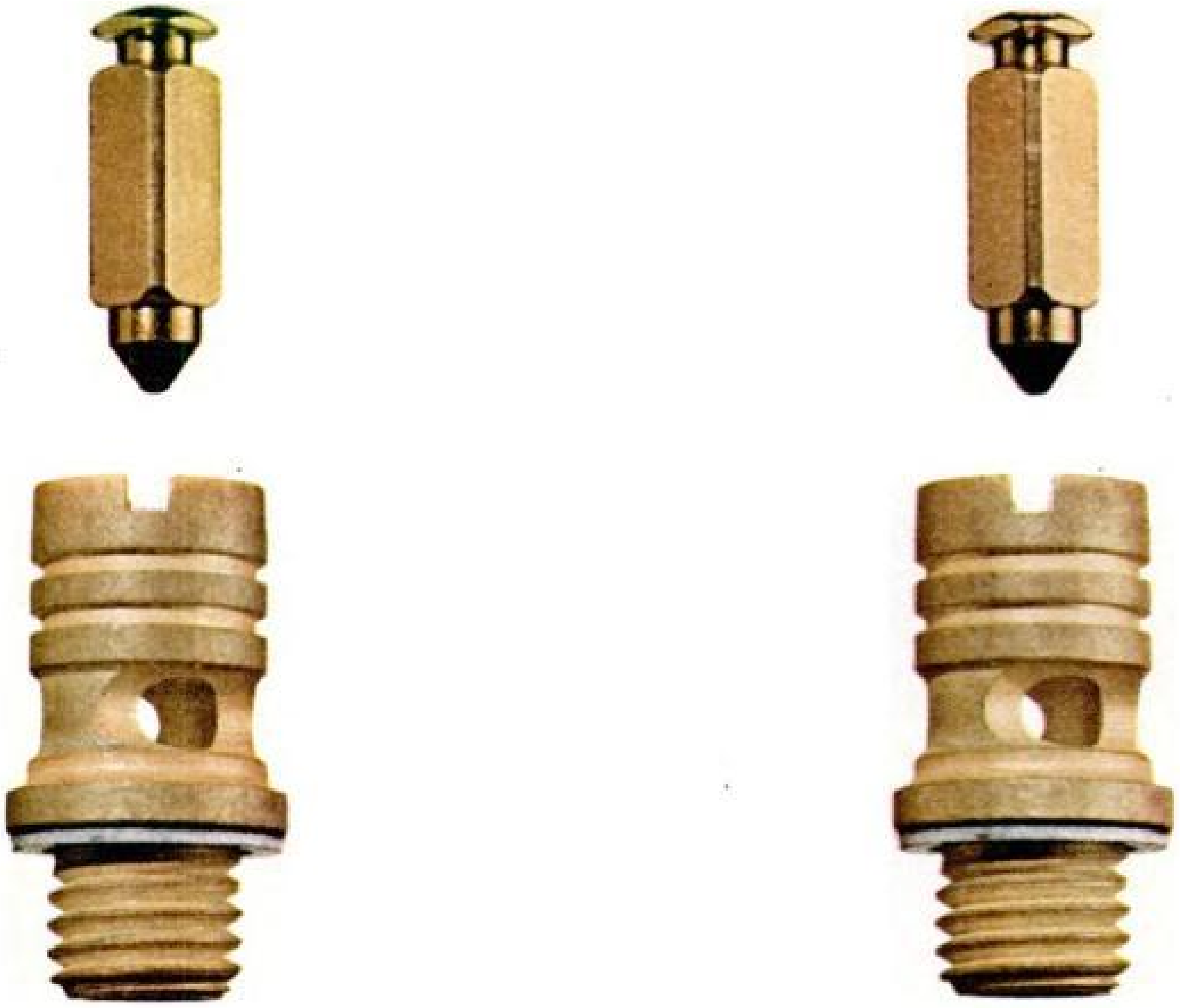

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valve-guide clearance. If none of these faults exists, or if correcting them does not help to clear up the trouble, I'm afraid you're in for a new ring job.

"How often should shocks be replaced? My '63 Buick LeSabre with only 17,554 miles on it has steering that is getting progressively more wobbly. The wheels have been rotated, lined, and balanced twice in 12 months. Can you help?"—Lester H. Hollans, Richmond, Va.

There is no set time for the life of shocks. They'll often last beyond 50,000 miles. Operating on substandard roads can shorten this considerably. For a rough check on yours, unloosen them all at one end. Feel them. A bad shock has little or no restriction to movement. If your shocks are okay, check the front suspension for worn ball joints and links. Also check the rear suspension—trouble there can also put a wobble in the steering. Incidentally, if the roads you drive over are rough, you should switch to heavy-duty shocks.

"My '64 Ford Custom 500 with standard transmission and overdrive came equipped with a mechanical interlock to prevent gear shifting unless the clutch pedal was fully depressed. With this gadget's exposure to dirt and snow, it just makes shifting more difficult. Last winter, when I couldn't shift gears at all, I took it off. How come they put it on in the first place?"—T. C. Rockcastle, St. Louis.

A few drivers learned to shift the overdrive transmission without using the clutch, and caused the dealers grief. So, the interlock. It's okay to remove it—if you remember to fully release the clutch when shifting, to prevent damage.

"Why do all cars today have a negative polarity?"—E. J. Devereaux, San Francisco.

Engineers seem to agree that negative polarity extends the life of distributor points and spark plugs.

Got a question on autos? Send it to:
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Please PRINT your name and address. Not every question may be used. Questions cannot be answered by individual letters.

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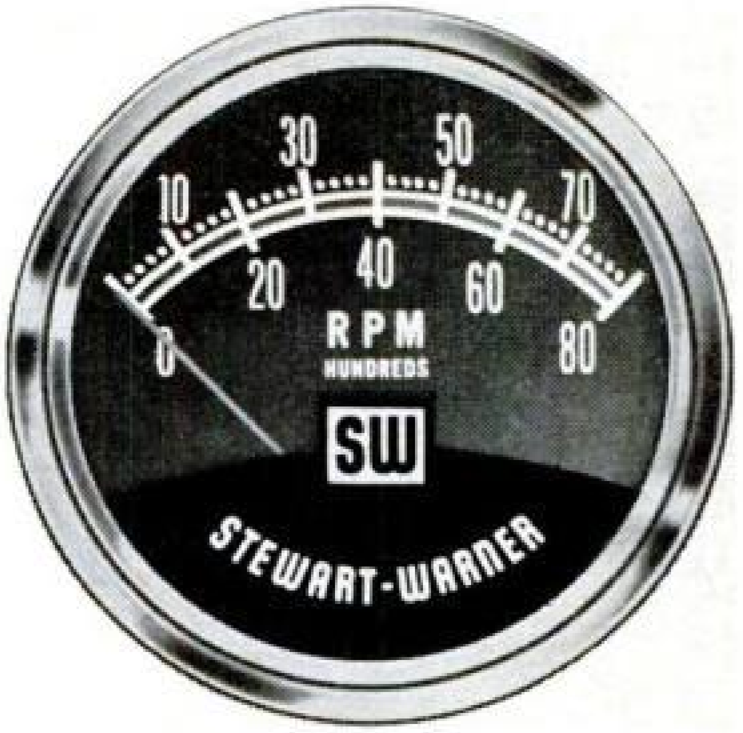

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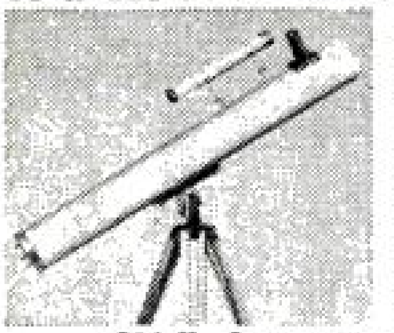

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Up to 576 Power Equatorial mount and Pedestal Base
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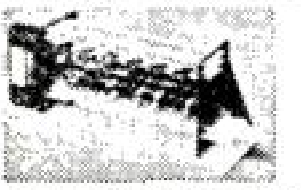

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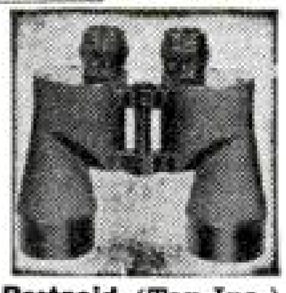

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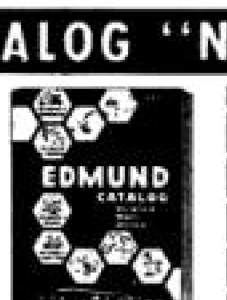

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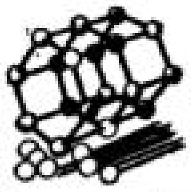

This low-priced kit can be used to make many molecular and crystal models. Consists of 50 sponge-rubber balls, 1 inch in diameter and 50 wooden sticks 6" x ⅛" that can be cut to any desired length. Balls may be painted, after assembly, to standard molecular colors. With this one kit, molecules with up to 50 atoms can be made. Several kits can be used to make up more complex models.
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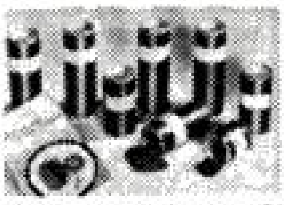

Do a crystallographic project illustrated with large beautiful crystals you grow yourself. Kit includes the book "Crystals and Crystal Growing" and a generous supply of the chemicals you need to grow large display crystals of potassium aluminum sulfate (clear), potassium chromium sulfate (purple), potassium sodium tartrate (clear), nickel sulfate hexahydrate (blue green) or heptahydrate (green), potassium ferricyanide (red), and copper acetate (blue green).
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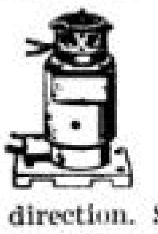

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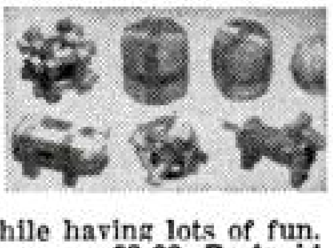

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More "Quasars" Found

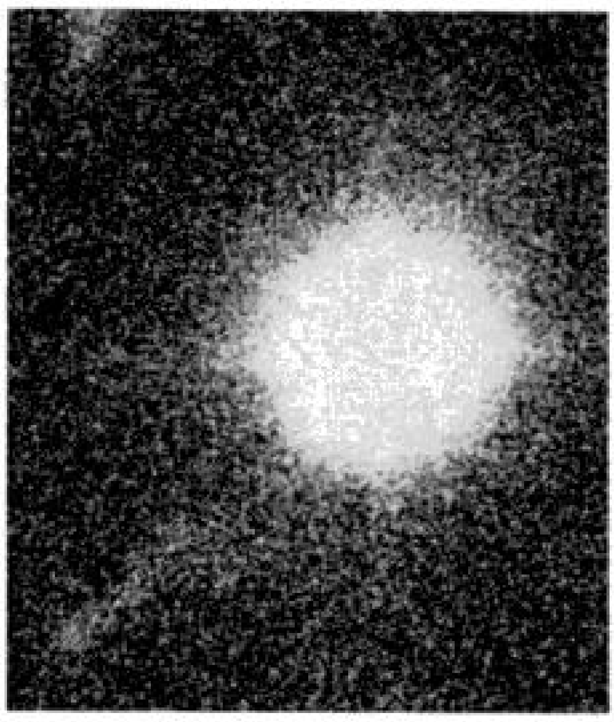
Astronomers seek clues to birth of universe in light arriving after billions of years

Excitement is mounting among astronomers as new discoveries add to the mystery of the celestial objects called quasars. More quasars are being identified all the time, and their nature has been made even more puzzling by the discovery of a class of related starlike things termed "interlopers." At a recent all-day press conference held by the American Institute of Physics, scientists tried to summarize developments in this chaotic field.

Of the billions of "stars" visible with the most powerful telescopes (actually, about half of them are galaxies like our own Milky Way galaxy), only 40 quasars and three interlopers have been pinpointed. But they may provide tantalizing clues to the creation of the universe, since their light has taken as much as 15 or 20 billion years to reach us. That's about the age of the universe, according to recent calculations.

If it's true that astronomers are now seeing events that were happening close to the birth of the universe, it's not surprising that the quasars are fantastically different from the kinds of stars and galaxies known before their discovery, just about two years ago.

They were named quasars because it was too hard to keep saying "quasi-stellar radio sources." That's what they were called when they were first discovered by astronomers using radio telescopes. Their positions were found to coincide with faint "nearby stars."



Quasar 3C273 shows typical gas jet, lower left. Photo: 200-in. Palomar telescope.

[Continued on page 22]

Pigeon's "Compass" Finds Patterns in Earth's Magnetism

An organ in the pigeon's eye, the pecten membrane, may be responsible for the bird's homing ability, according to Dr. Lester Talkington of IBM Systems Research Institute (NYC).

He bases this hypothesis on mathematical analysis of the shape of the membrane (of unknown function until now) and on pigeon-flight observations.

A fan-shaped organ on the optic nerve in each eye, the pecten is ideally constructed to detect small voltages induced by the earth's magnetic field as the pigeon flies.

A pigeon circling after release in a strange location presumably is seeking a pattern of magnetic forces similar to that near home, and flies in the direction of the most familiar pattern.

With the aid of the Army Signal Corps, Dr. Talkington followed flocks of pigeons by plane, comparing their routes to magnetic data plotted on a map. Flights followed curving paths conforming to the theory.

New clock: Tuning fork teams with crystal

A super-accurate, battery-powered electric clock smaller than a pack of cigarettes has been designed by Bulova. It combines the tuning-fork principle of the Accutron watch with a vibrating quartz crystal. The crystal, oscillating at 11,520 cycles a second, serves as a time standard to keep the tuning fork vibrating accurately at 360 cycles per second. The tuning fork, in turn, drives the clock mechanism. The "Accuquartz" clock varies no more than three seconds per year. It's not for sale yet.

Test your automotive I.Q.

What's the function of this ball-joint tester?

What does this symbol stand for?

The gauge tests side and top "play" of ball joints—part of required auto safety checks in three U. S. states. The life preserver means Quaker State Motor Oil—the best engine life preserver for your car. Made from 100% Pure Pennsylvania Grade Crude Oil, Quaker State helps keep your car on the road, out of the repair shop, save you money. Quaker State your car —to keep it running young.

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Science Newsfront

Continued

But careful analysis of the spectrum of the light produced by the objects showed that they could not be stars, nearby or otherwise. Some of the astonishing conclusions about what was happening when the light started toward us:

- The quasars have been moving away from us at speeds ranging from 15 percent to more than half of the speed of light. Since the universe is expanding, and it has been observed that the fastest-moving objects are those farthest away, the quasars were from 1.8 billion to 15-20 billion light years away—making some of them the most distant objects yet seen in the universe.
- The quasars appear faint because of their great distance, but actually they were the most luminous objects in the universe, about 100 times brighter than our galaxy, and were pouring out about 100 times as much light energy as a typical galaxy. However, they were considerably smaller than galaxies.
- Titanic explosions were taking place within the quasars. This is shown by their strong output of radio energy, by the enormous jets of luminous gas that are seen spurting out of almost all quasars, and by the wild fluctuation of their light ouput from month to month and from year to year.

Some scientists think these phenomena must have been caused by "gravitational collapse" of giant clouds of gas pulled together by their own mass.

A new and more conservative theory advanced by Dr. George Field of Princeton is that we are seeing early stages in the normal evolution of galaxies.

A quasar, he says, is a young galaxy (about a million years old) in which some 50 billion stars have been formed from the condensation of a cloud of hydrogen gas. Of these stars, about 100 million are the brightest type with the shortest lifetimes. They burn out randomly at the rate of about 100 supernova explosions per year, producing the fluctuations in the quasar's light.

The "interlopers" may be quasars before or after this period of activity. They were discovered by Dr. Allan Sandage, of Mt. Wilson and Palomar Observatories, as a result of a peculiarity in the light output of quasars—they emit light strongly at the ultraviolet end of the spectrum.

[Continued on page 24]

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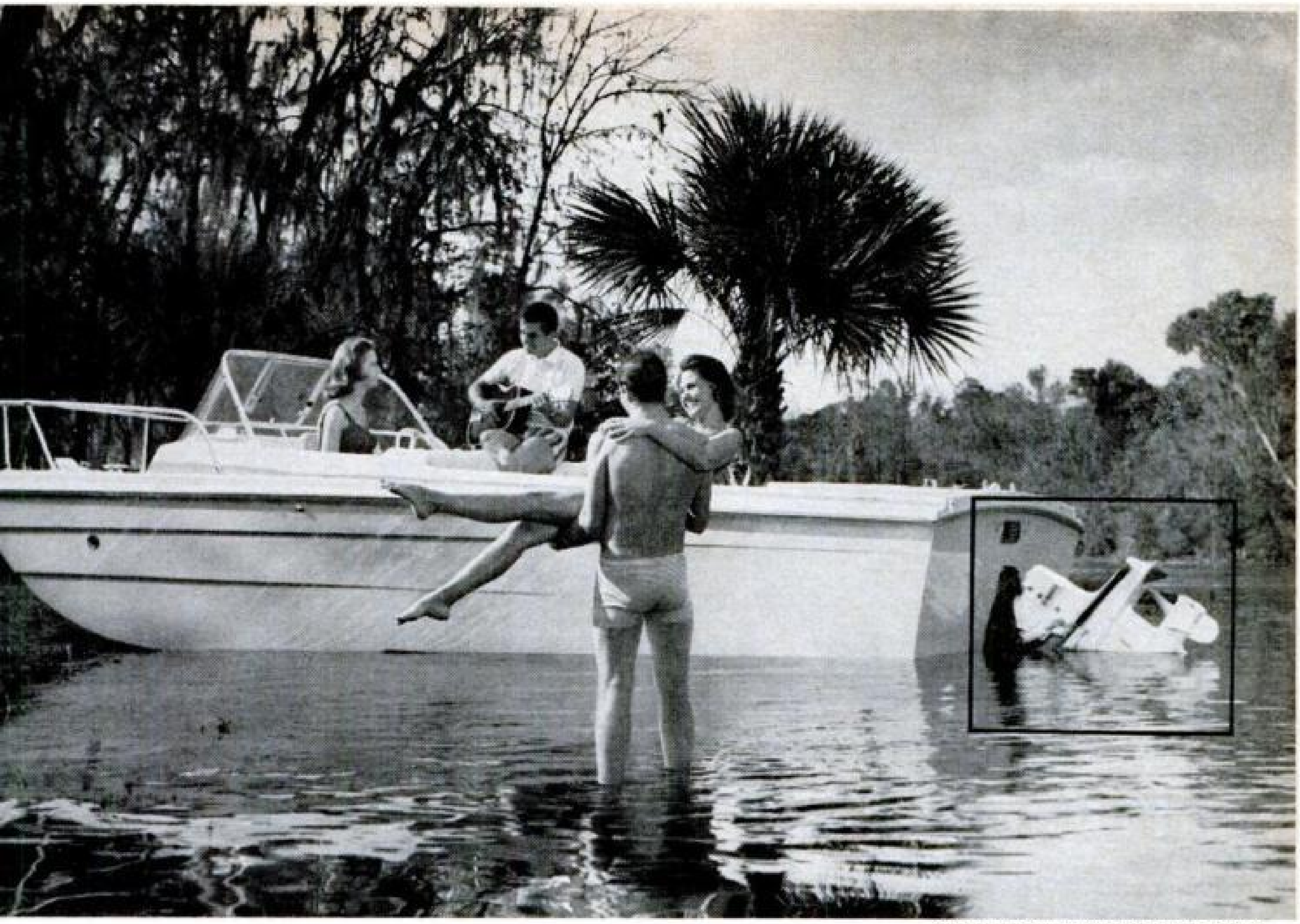

PHOTOGRAPHED AT FLORIDA'S SILVER SPRINGS

What has the tilt-up advantages of an outboard yet swings a prop as big as an inboard?

MerCruiser Stern Drive. MerCruisers, like an outboard, can run right up on the beach without damage to drive unit or propeller. MerCruiser's drive unit tilts up, to clear the bottom f the boat . . . no fixed, angled shafts, struts, r rudders on the bottom. This makes IerCruiser easier to launch, easy to trail nd lets you run safely in shallow water.

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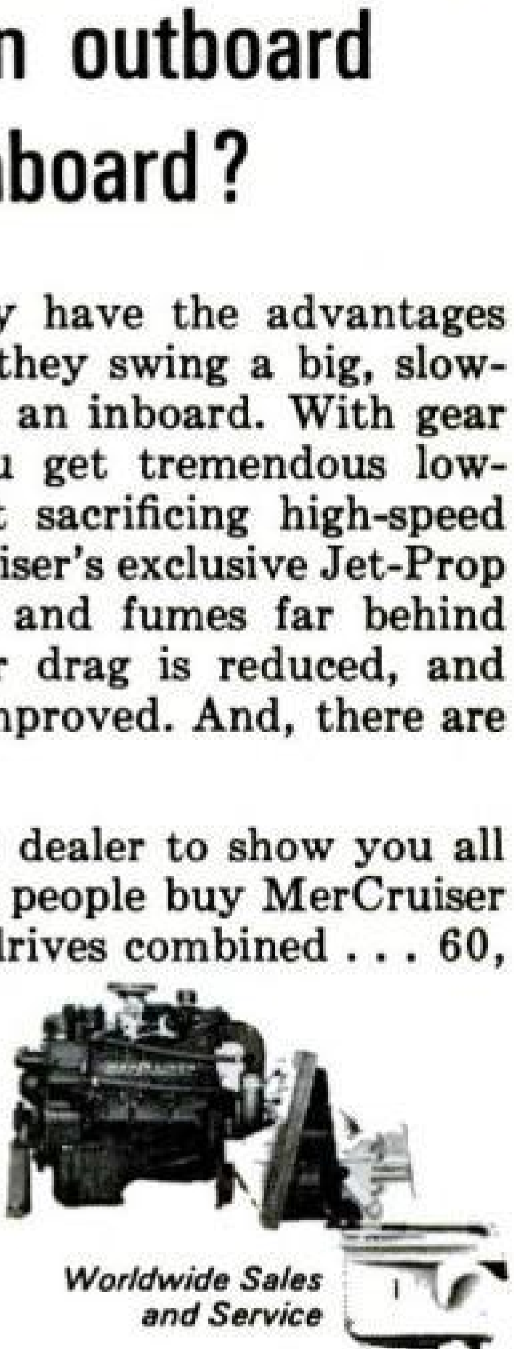

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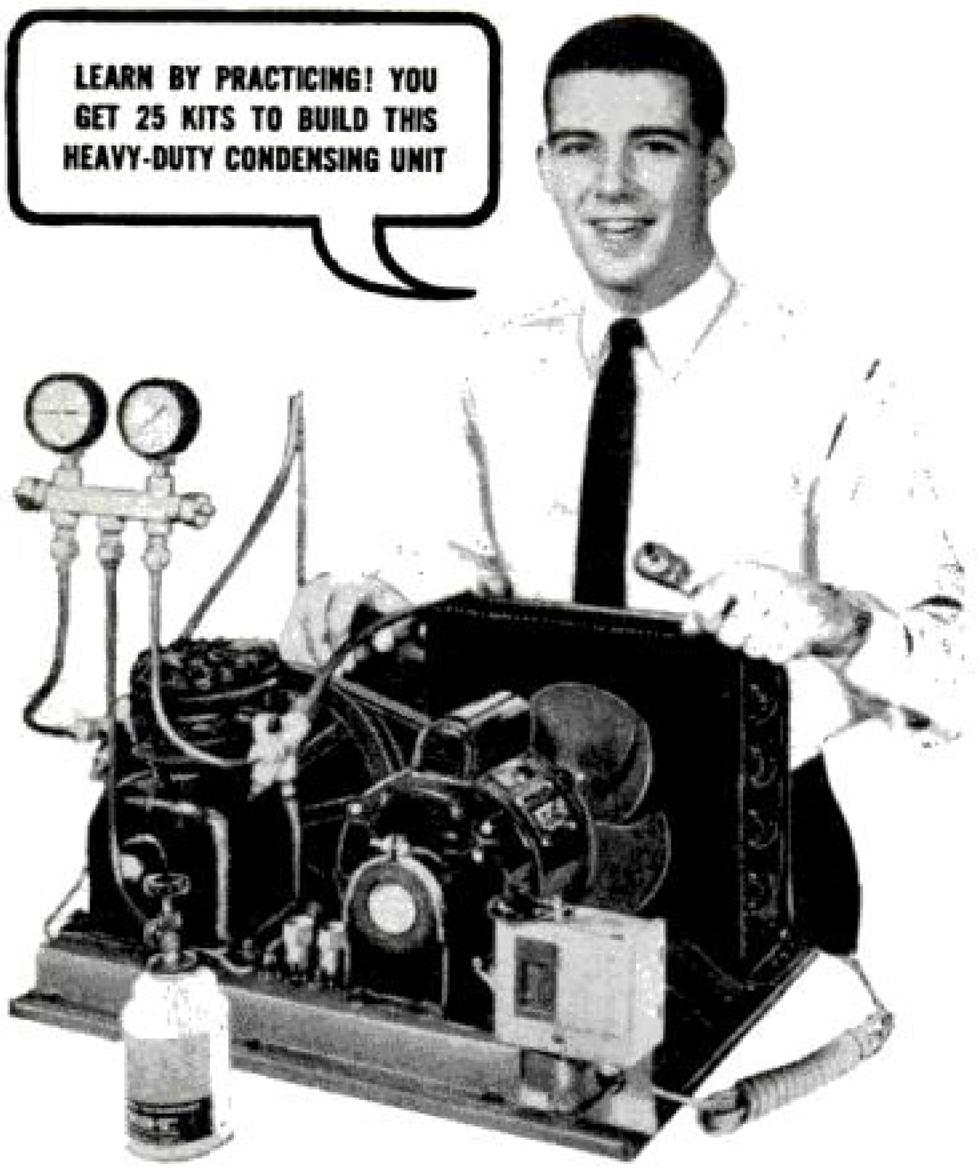

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By taking pictures of regions of the sky through the telescope, using a filter that lets ultraviolet through but blocks out most other light, Sandage has positively identified at least three objects that are like quasars except that they are not radio sources. He thinks there may be tens of thousands of these interlopers in all.

The number of quasars may run into the hundreds. As more are identified, they should provide a fascinating insight into the evolution of the universe.

Mohole to be drilled in Pacific near Hawaii

Weather was the key factor in the U.S. decision to drill the Mohole in the Pacific, about 100 miles from the Hawaiian Islands.

Project Mohole, which has been getting under way since 1959, is the plan to drill a hole all the way through the earth's crust to the mantle, a region of unknown composition. It is named after the Mohorovicic Discontinuity, or Moho, a transition zone in which earthquake waves change speed.

The National Science Foundation decided, on the advice of a committee of oceanographers, that drilling will take place in an area where the water is 14,000 feet deep and the Moho is another 14,000 to 17,000 feet below the ocean floor. The Mohole will be drilled from a floating platform because the earth's crust is thinner under the oceans than under the continents.

A site that had long been considered likely was the 27,500-foot-deep Puerto Rico Trench, where the crust is believed to be very thin. This location was ruled out, according to the NSF, because it is in a hurricane belt.

Construction of the drilling platform under Brown & Root, Inc., the prime contractor, should get under way soon, at a cost of about $70 million. Drilling may begin in 1968.

The Mohole, if successful, will yield samples of rock from the mantle that are expected to shed light on the earth's mysterious interior and the causes of earthquakes.

Atomic shopping gets easier —megawatts for megabucks

Atomic power plants can now be ordered out of a catalogue. General Electric lists a wide range of sizes and styles. The price range is from $15 million (for a 50,000-kilowatt reactor) to $103 million for the giant size (a million kilowatts). ■ ■

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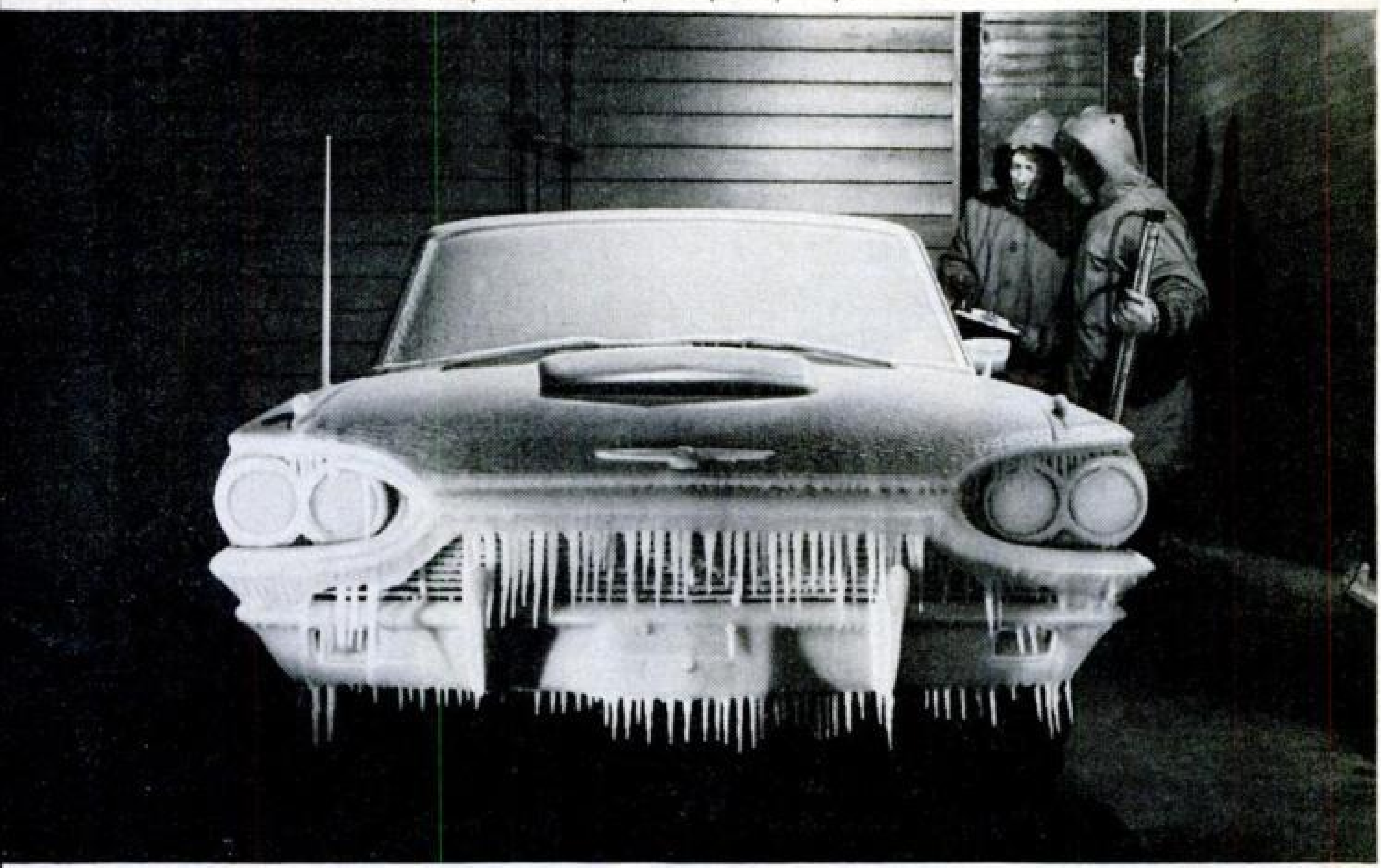

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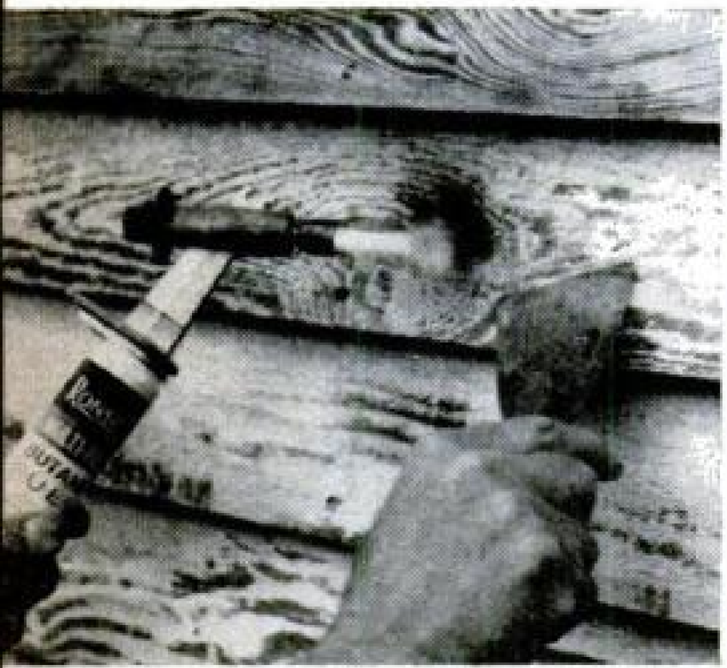

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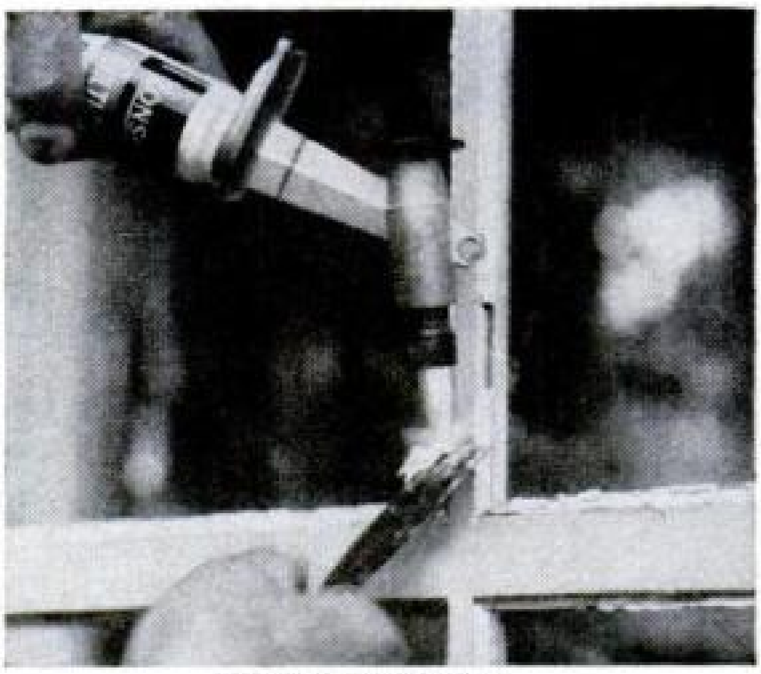

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O.K. You own a hammer, a chisel, a screwdriver—a lot of good, hardworking tools.

So when something at your house needs fixing, you're ready, willing and able to go to work.

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Ever try to thaw a frozen water pipe with that hammer?

Or unstick a cracked floor tile with that screwdriver?

Or chip ice off the front steps with that chisel?

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(Not having the right tool at the right time can make you feel about as self-sufficient as an old-maid schoolteacher fixing her first flat tire.)

But now Ronson has a new torch that can do all those things. And more.

You don't have to be a handyman to put it to work. It starts charcoal and log fires quickly. It burns leaves and caterpillar nests. You can even use it to put a nice brown meringue on Baked Alaska!

It weighs less than 13 ounces. Much smaller than other leading torches, it takes very little storage space. It's as compact and easy to handle as a flashlight.

A blast from this torch can spot-kill a weed faster than you can yell "Crabgrass!"

A broken wire fence needs mending?

This torch can do a perfect soft-solder job in less than a minute.

It can hard-solder a ½" c
per tube to a brass elbow in j
a few minutes.

It can help remove old pai
Soften old putty.
Fix a kid's toy.
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(Whew!)

Loosen rusted pipe fitti
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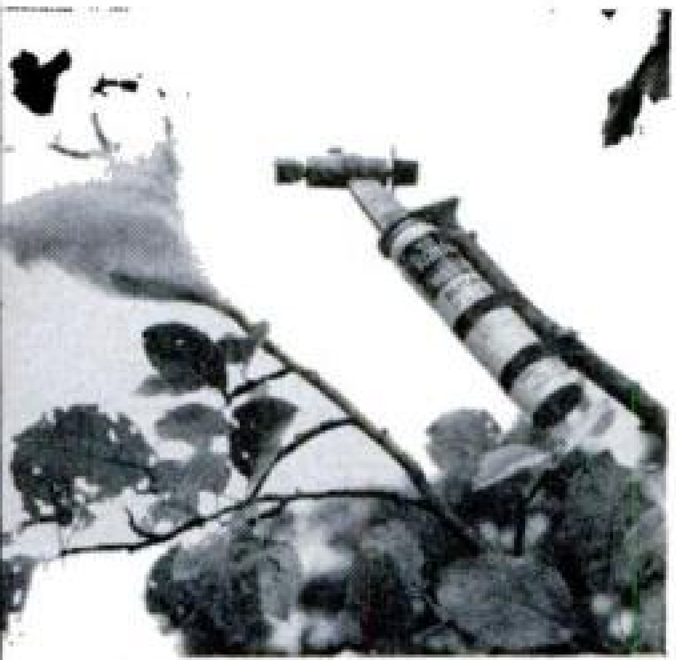

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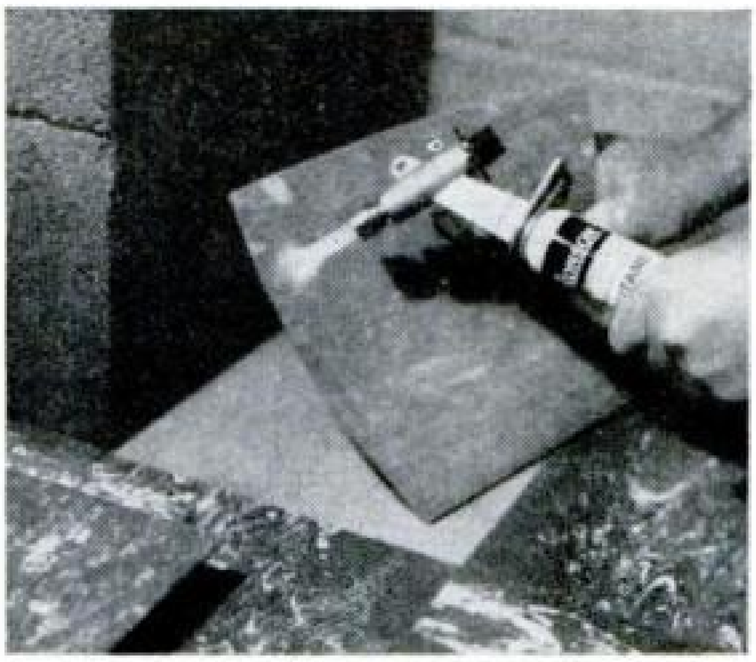

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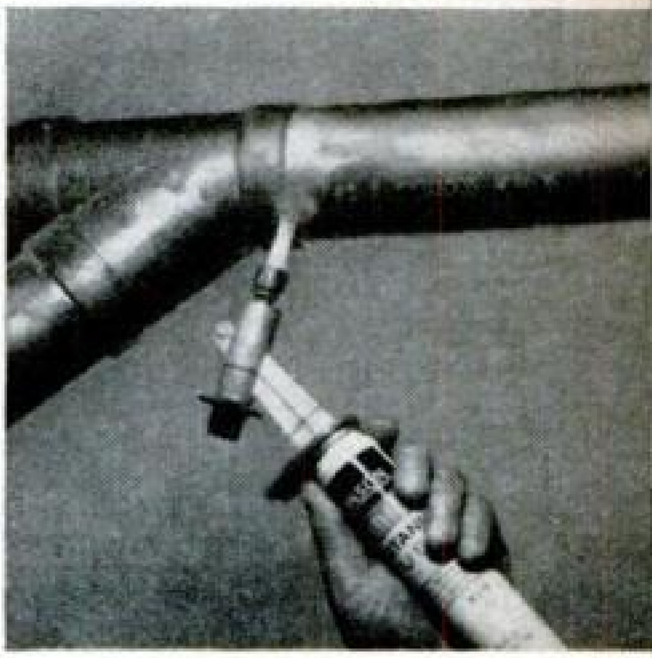

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It snaps onto the Multi-Fill injector. You don't have to be a professional plumber to use it.

A fingertip knob controls the flame precisely. You get the bluest flame possible. The steadiest pinpoint flame. (The steadier and bluer the flame, the more intense the heat, the faster the job gets done.)

And you won't have to take this torch apart to clean it between jobs. It's completely self-cleaning. **It just won't clog.**

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Where can you get your hands on the new Ronson Varaflame Torch?

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Isn't that a small price for this amazing torch?

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Getting Ahead

By Dr. Lewis R. Fibel

A monthly column to help you prepare yourself for a better job

What jobs hold the most prestige in the U.S.? Basing the answer on a sampling of American adults, the National Opinion Center of the University of Chicago can tell you.

A recently released draft of a report under preparation lists the top four ratings (in descending order) as follows: U.S. Supreme Court justice, physician, nuclear physicist, and scientist.

In general, the professions enjoyed a higher rating than occupations in business, industry, the arts, or politics.

Lower on the list, policemen beat out reporters, radio announcers, bookkeepers—who trailed in that order.

"To move up in my job, I need refresher training in algebra, analytics, and calculus. Would teaching machines help me? Peculiar working hours prevent my going to night college."—L.T.B., Fort Lee, N.J.

I'd recommend that you take a correspondence course rather than try to "refresh" your skill by working through a text or using a program. A course will involve one or the other of these techniques, yet have the added advantage of being an ordered and integrated experience for you. It is very difficult to set your own pattern of learning without the help of an expert.

Many colleges offer appropriate correspondence courses. Among them: U. of Tenn., Box 8540, Knoxville 16; U. of Texas, Austin 12; U. of Wisconsin, Madison 6; U. of Wyoming, Laramie.

"So many homes are being air-conditioned, requiring a lot of ducting, that I'd like to take up sheet-metal work. But where?"—F.S., Dallas.

Most training authorities recommend an apprenticeship as the best way to learn this trade. You can also learn the skill informally by working as a helper. There are correspondence courses, too: American School, Drexel at 58th St., Chicago 60637; International Correspondence Schools, Scranton, Pa. 18515.

You might check with the Dallas Public Evening School (2218 Brian St.), and if they cannot help you, the principal may be able to refer you to a nearby public vocational school that does have courses.

Distant trade schools: Sheet Metal Building Trades School, 2139 Trombley St., Detroit; Welding and Metal Trades School, 575 Atlantic Ave., Brooklyn, N.Y.

"Where, and what, should I study to be a forester?"—P.B., Chicago, Ill.

The management, protection, and development of forests is big business, with foresters employed by the federal and state governments as well as timber-holding industries. To carve out a career in this field, you'd need a bachelor's degree with a major in forestry.

More than 40 U.S. colleges (28 accredited by the Soc. of Amer. Foresters, 704 17th St. N.W., Washington 6, D.C.) have forestry departments. Among those in your area: U. of Illinois, Urbana; Purdue U., Lafayette, Ind.; Iowa State U., Ames; Michigan State U., East Lansing.

"Everybody tells me I have a good speaking voice (no asset in my job, now), and off-the-cuff speaking and meeting with people is easy for me. What career would such talents suggest?"—R.L.M., Charlotte, N.C.

There are many careers where your natural abilities would be assets. A few examples: actor, radio or TV announcer, "voice" for industrial motion pictures and radio commercials, salesman, hotel or restaurant manager, public-relations executive, tour manager, lecturer, product demonstrator, lawyer, clergyman.

You can profitably do two things: Learn more about careers, and learn more about yourself. Books like *Selecting an Occupation* by Prosser (McKnight & McKnight,

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- Insure maximum gas economy and quiet engine running. Read the exact RPM while the engine is in neutral position. Then adjust the carburetor in conformity with the car manufacturer's recommendations.
- To locate a "miss" you need only disconnect or "short" the spark plugs one at a time with the Model BT-162 switched to the Tachometer position.
- Cars with automatic transmissions function efficiently only if the fluid pressures are correctly maintained and since manufacturer's instructions always refer to RPM, the Model BT-162 (or an equivalent tachometer) is required to properly service automatic transmissions.

Specifications

The Model BT-162 provides three dwell angle scales; 0 to 45 degrees, 0 to 60 degrees, and 0 to 90 degrees. The three dwell angle ranges specified above make this instrument suitable for making accurate dwell angle adjustments on all 4 cylinder, 6 cylinder, and 8 cylinder cars, both foreign and domestic.

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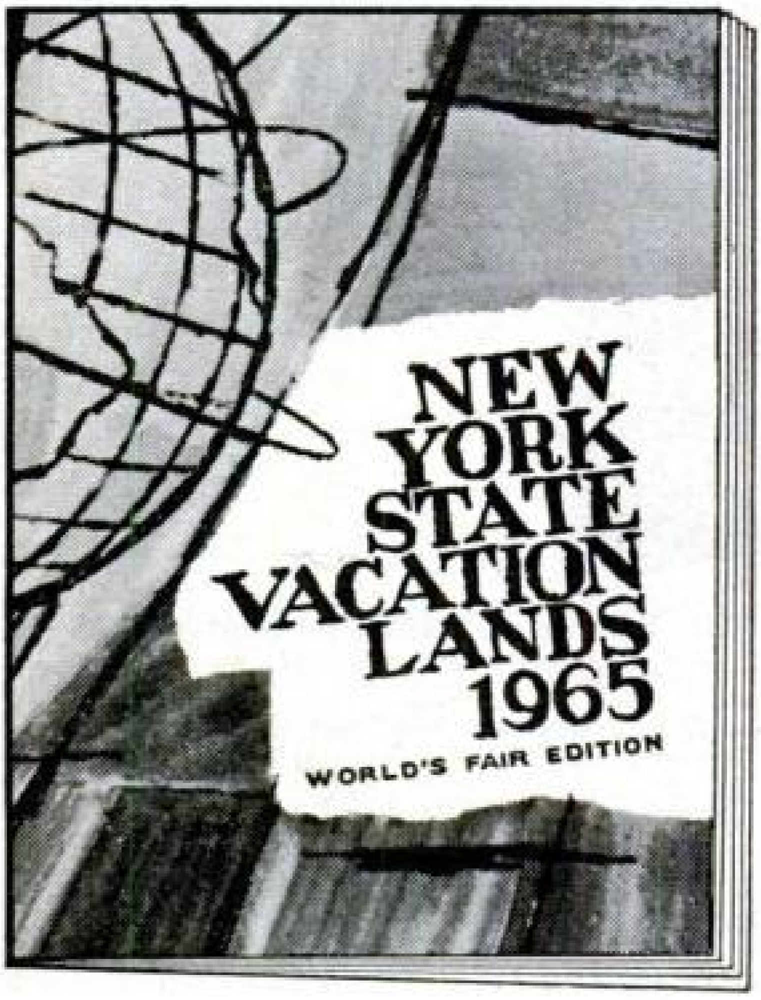

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"I'm interested in a career as a jet airline pilot. Can you brief me?"—L.B., NYC.

Airline pilots and copilots must hold a commercial airplane pilot's license issued by the Federal Aviation Agency (FAA). In addition, an "instrument rating" is required for flying on instruments in bad weather, and also a rating for the specific class (multi-engine, jet) and specific type of plane (DC-6, 707, etc.).

The skills and flying hours (200) can be acquired in military service or through a private flying school. Detailed information can be obtained from the Air Line Pilots Assn. International, 55th St. at Cicero Ave., Chicago 60600.

"I'm about to lose my job to a machine. I read 'Wanted: 500,000 Computer Men' [Jan.] and I aim to fight back. Where can I learn programing?"—L.B., Miami.

A steadily increasing number of schools and colleges are training programers and other workers for data processing. Among private technical schools: American Inst. of Engineering, 1143 W. Fullerton Parkway, Chicago 14; Columbia (S.C.) Com'l College, P.O. Box 1196; DeVry Tech. Institute, 4141 Belmont Ave., Chicago 41; Greenleaf School of Business, 193 Peachtree St., Atlanta; Milwaukee School of Eng., 1025 N. Milwaukee St.; RCA Institute, 350 W. 4th St., NYC 14; Valparaiso (Ind.) Tech. Institute. The University of Florida at Gainesville also trains programers.

"Can you suggest some place in my city where I can study auto mechanics?"—M.J.T., Sacramento, Calif.

Yes. Sacramento Junior College.

• •

Send your questions on careers and technical training to:
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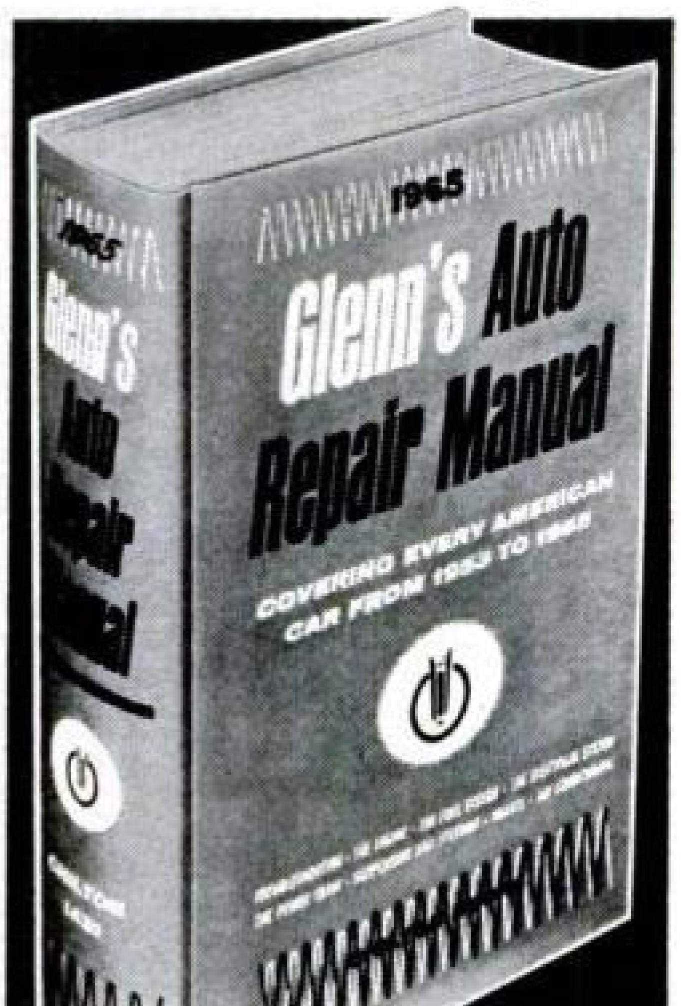

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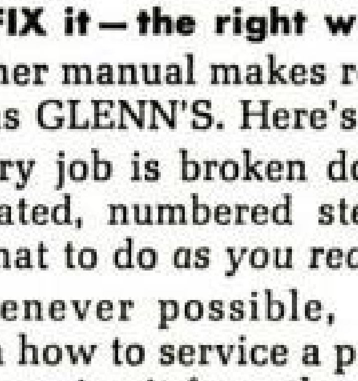

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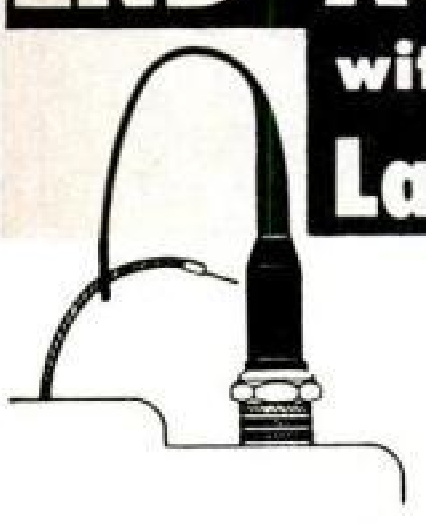

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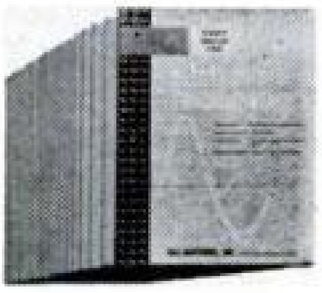

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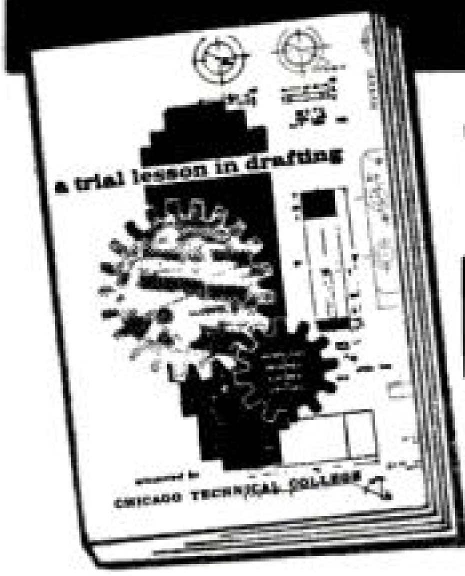

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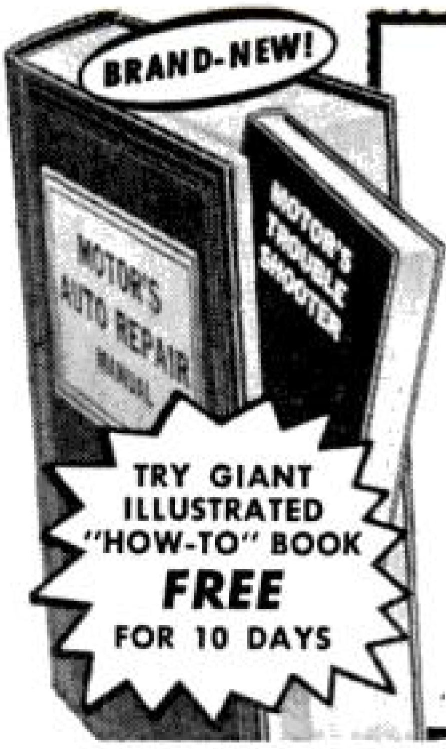

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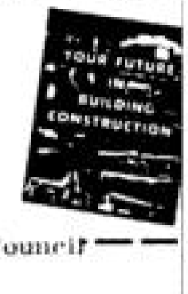

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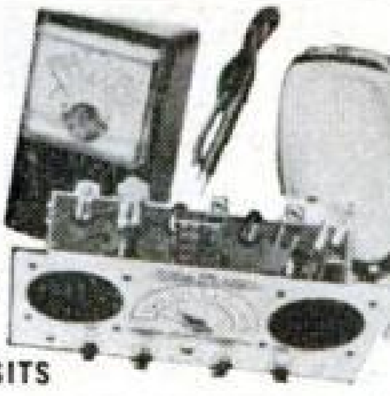

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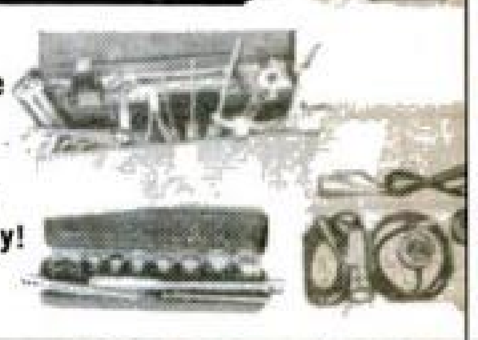

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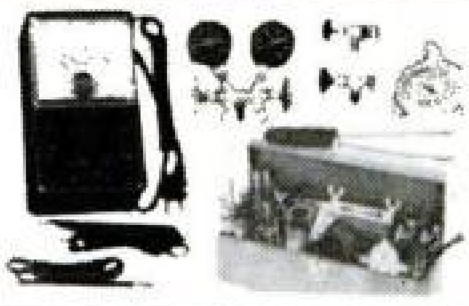

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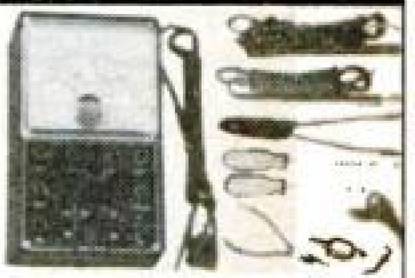

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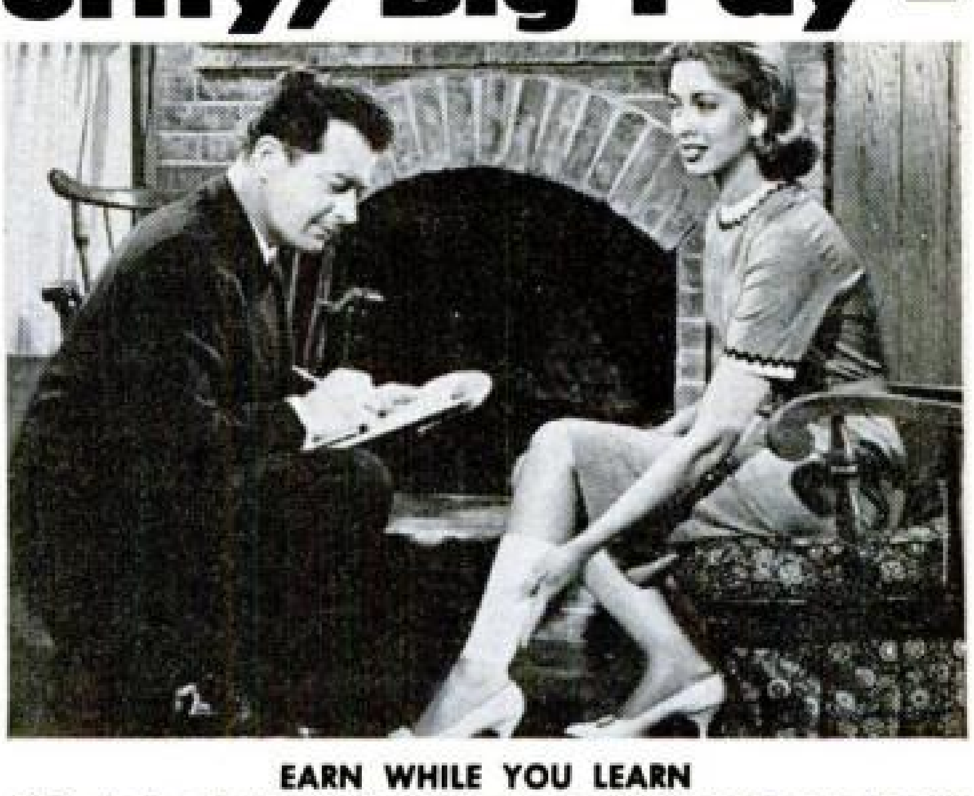

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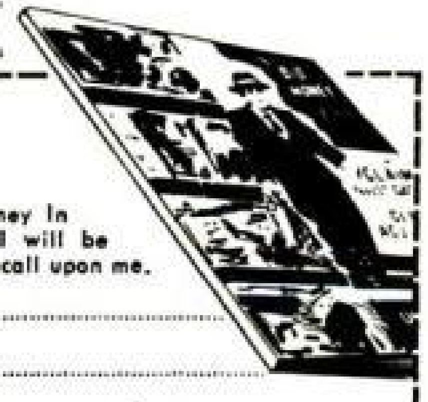

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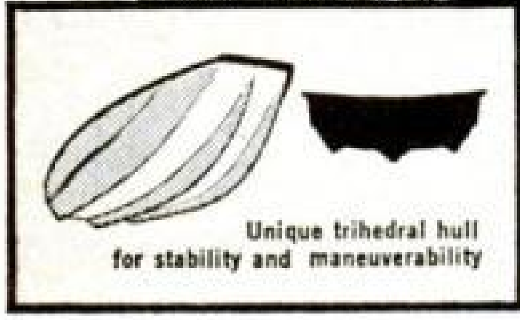

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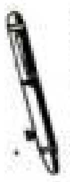

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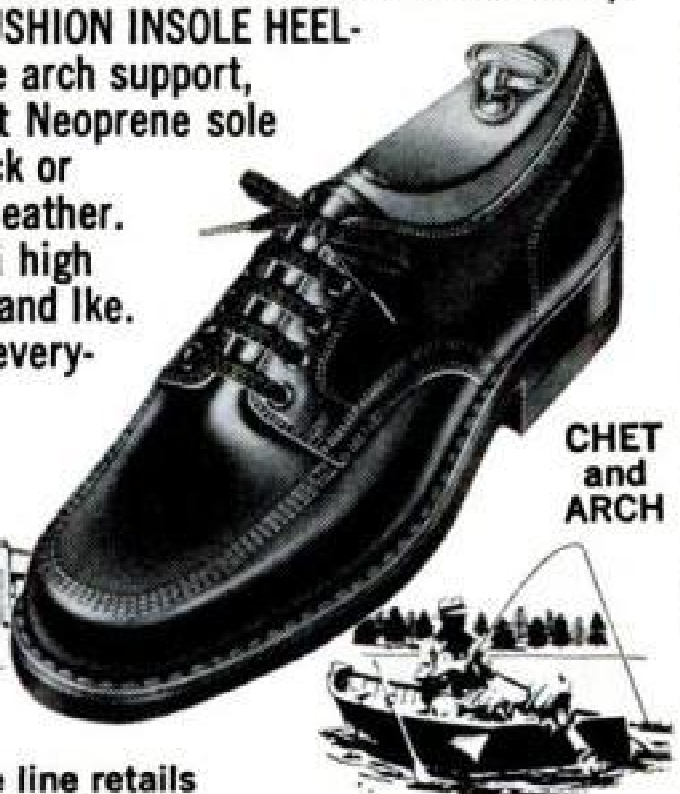

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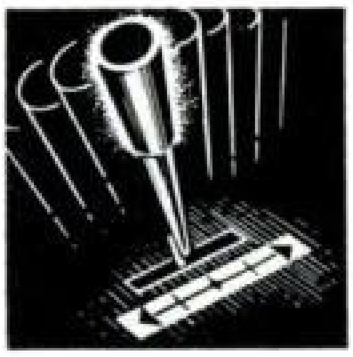

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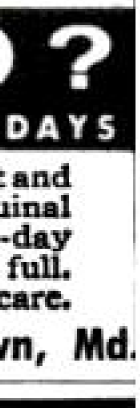

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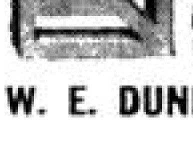

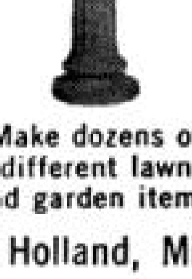

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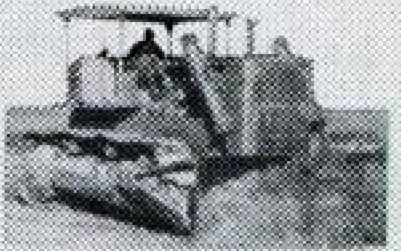

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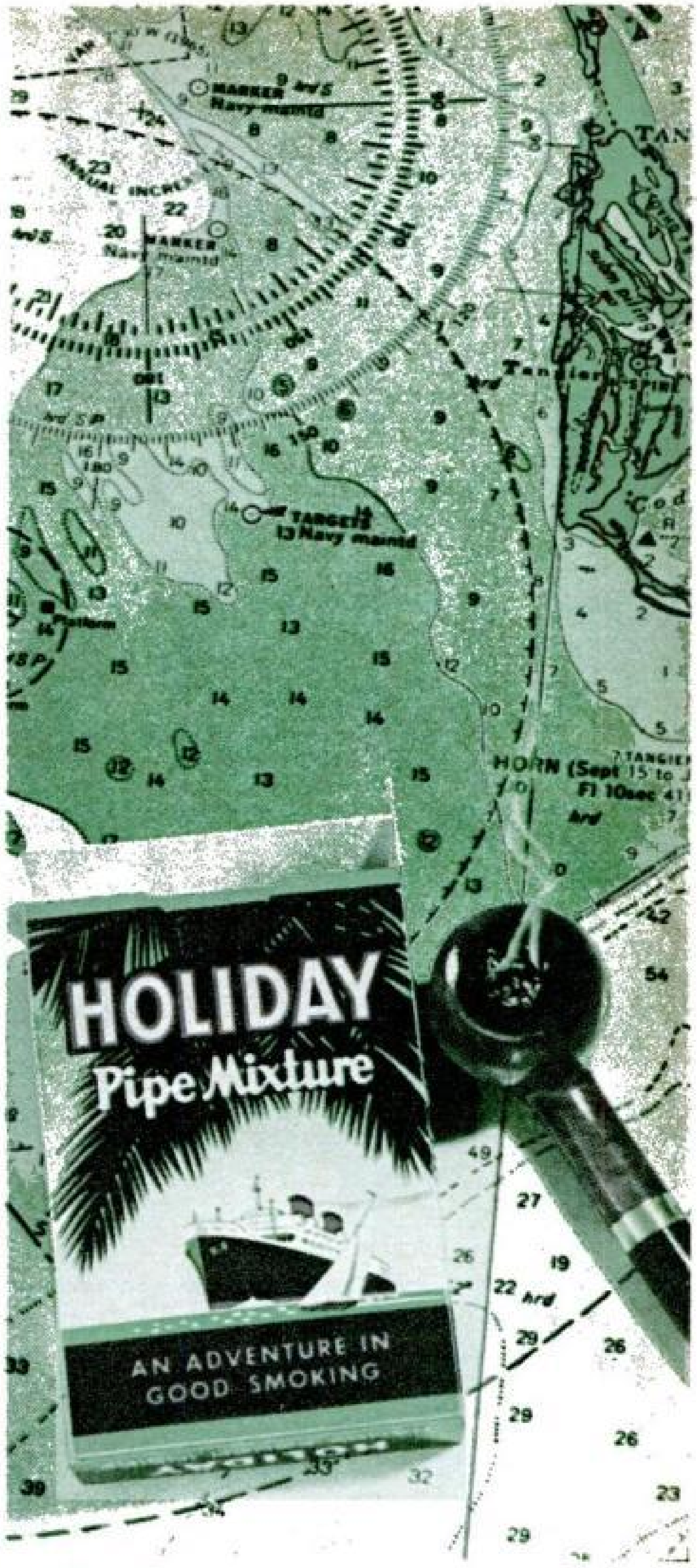

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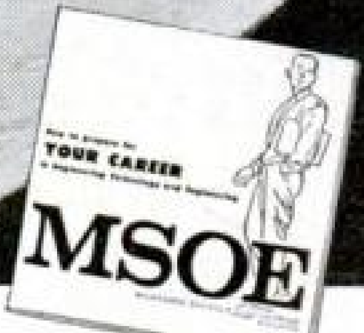

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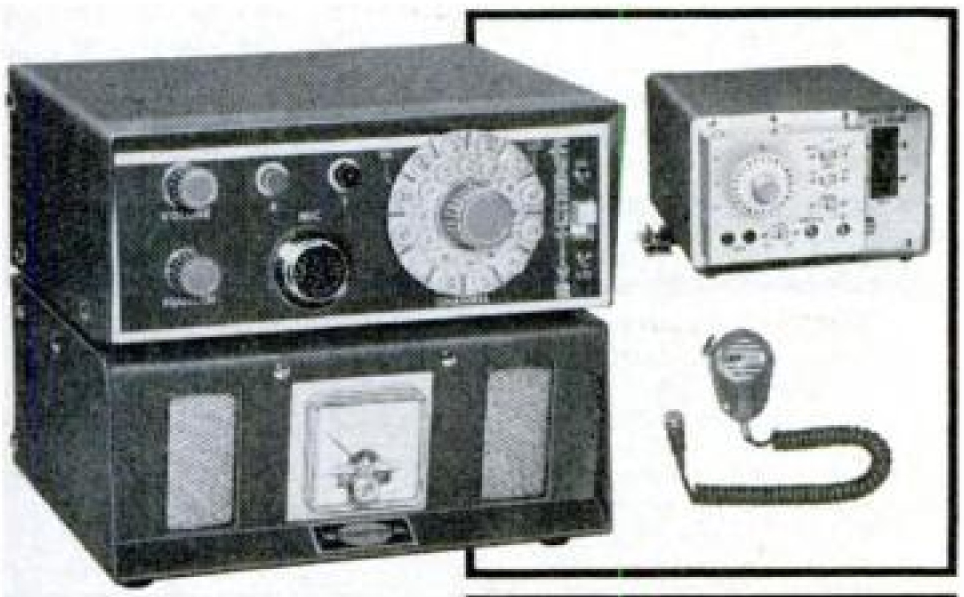

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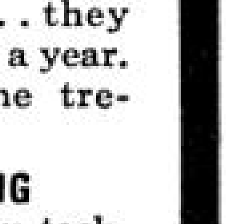

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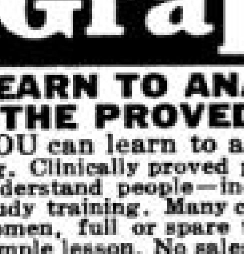

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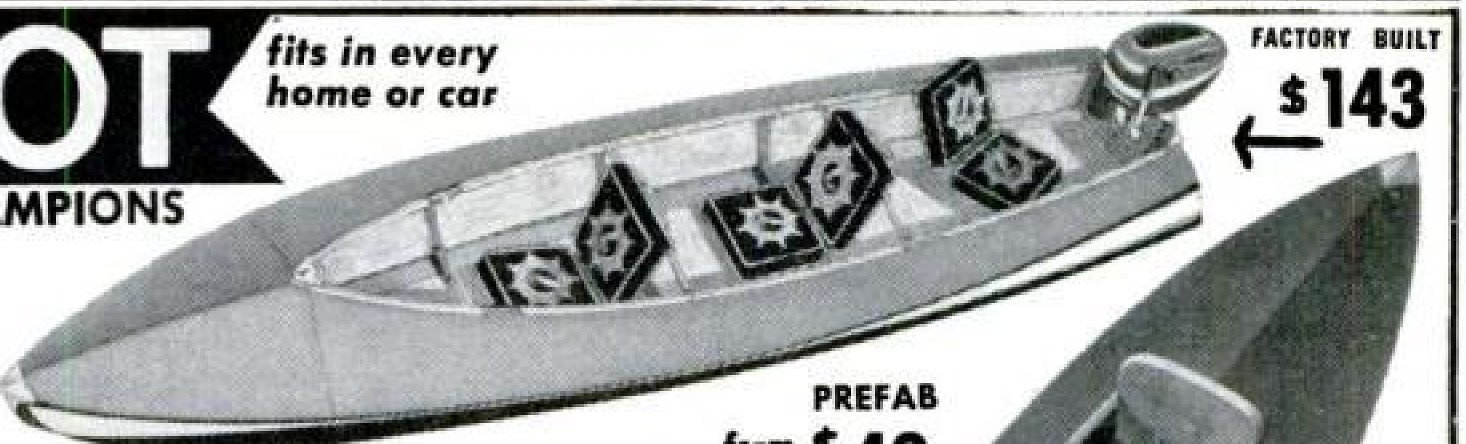

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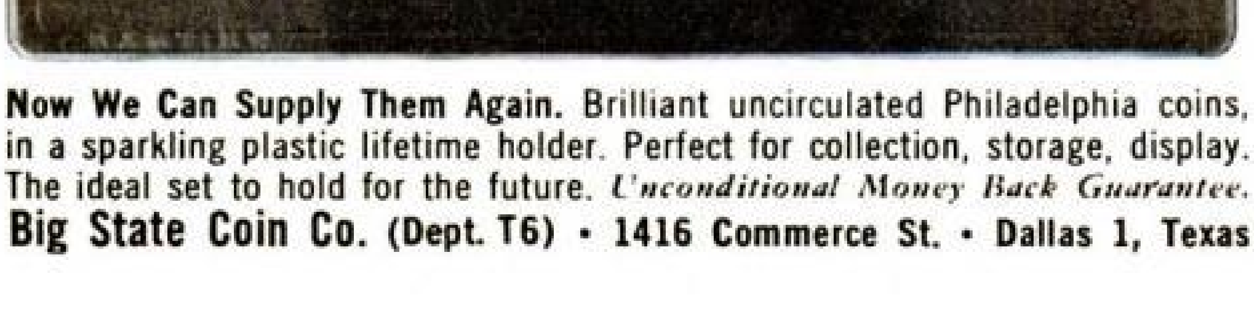

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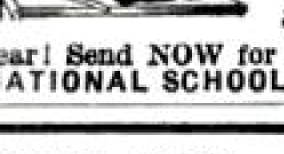

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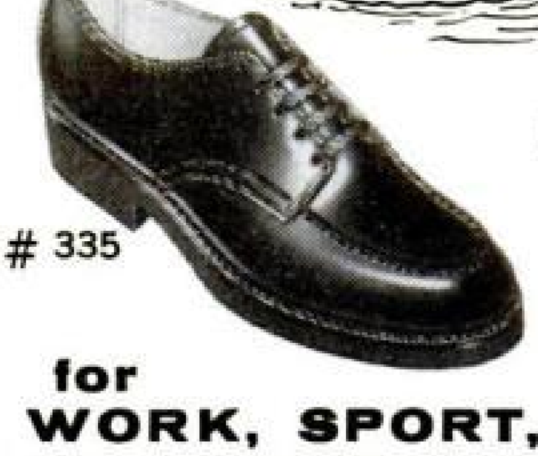

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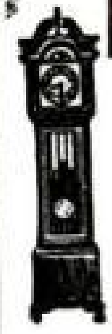

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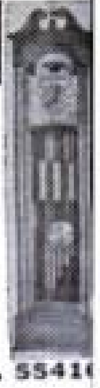

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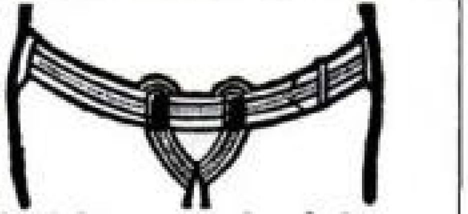

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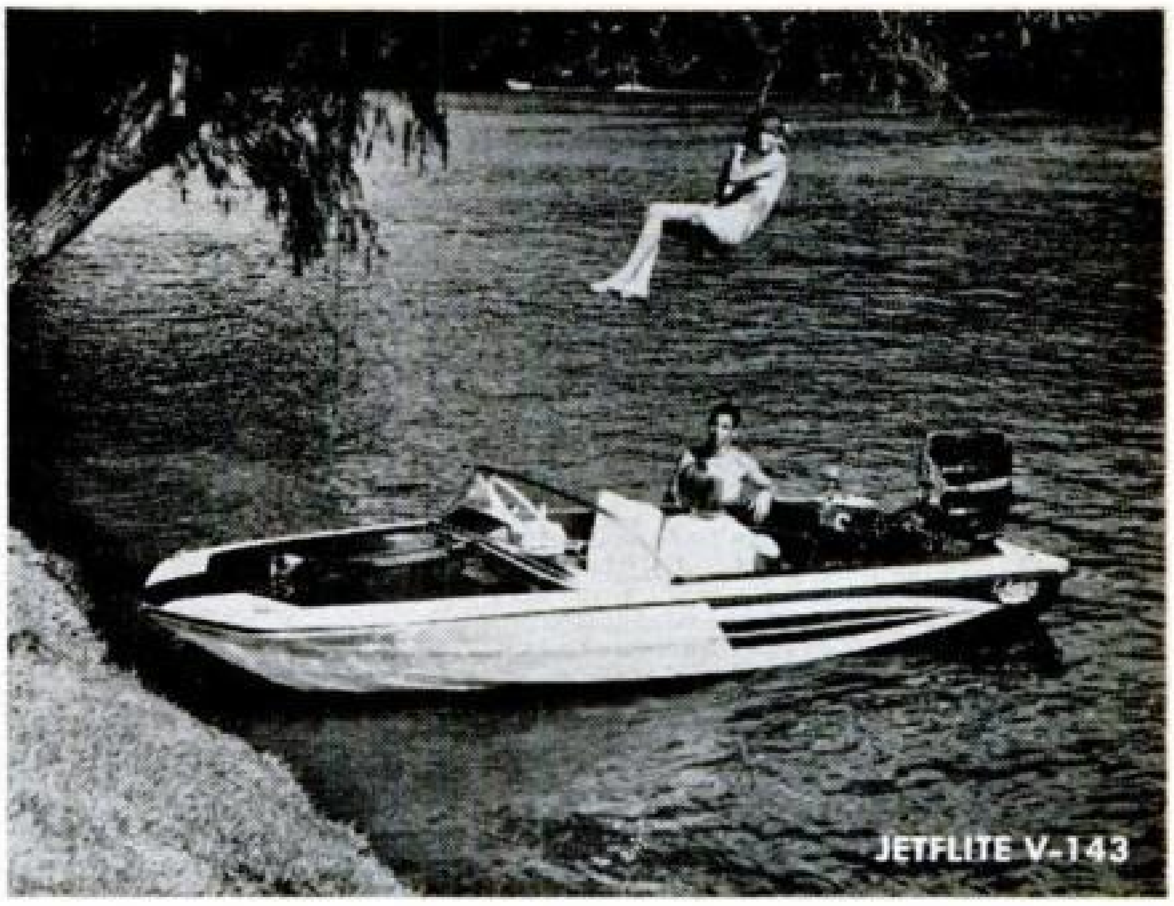

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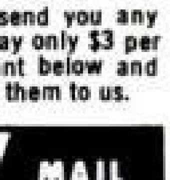

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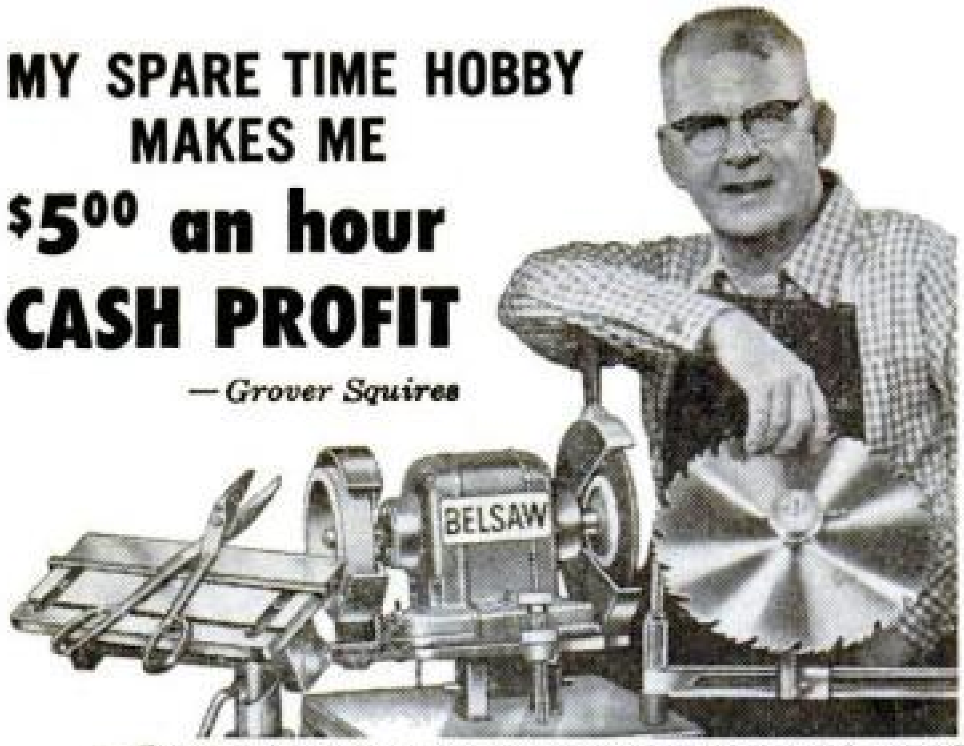

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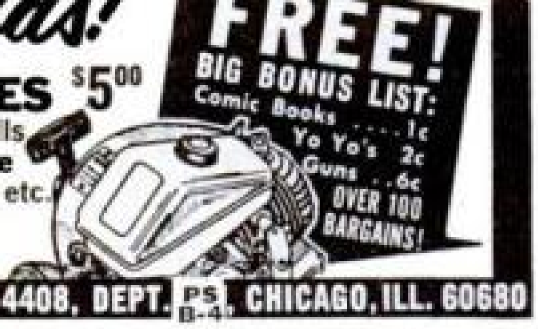

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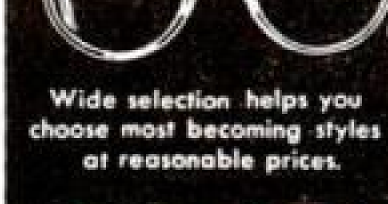

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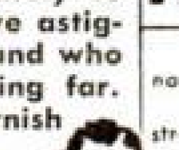

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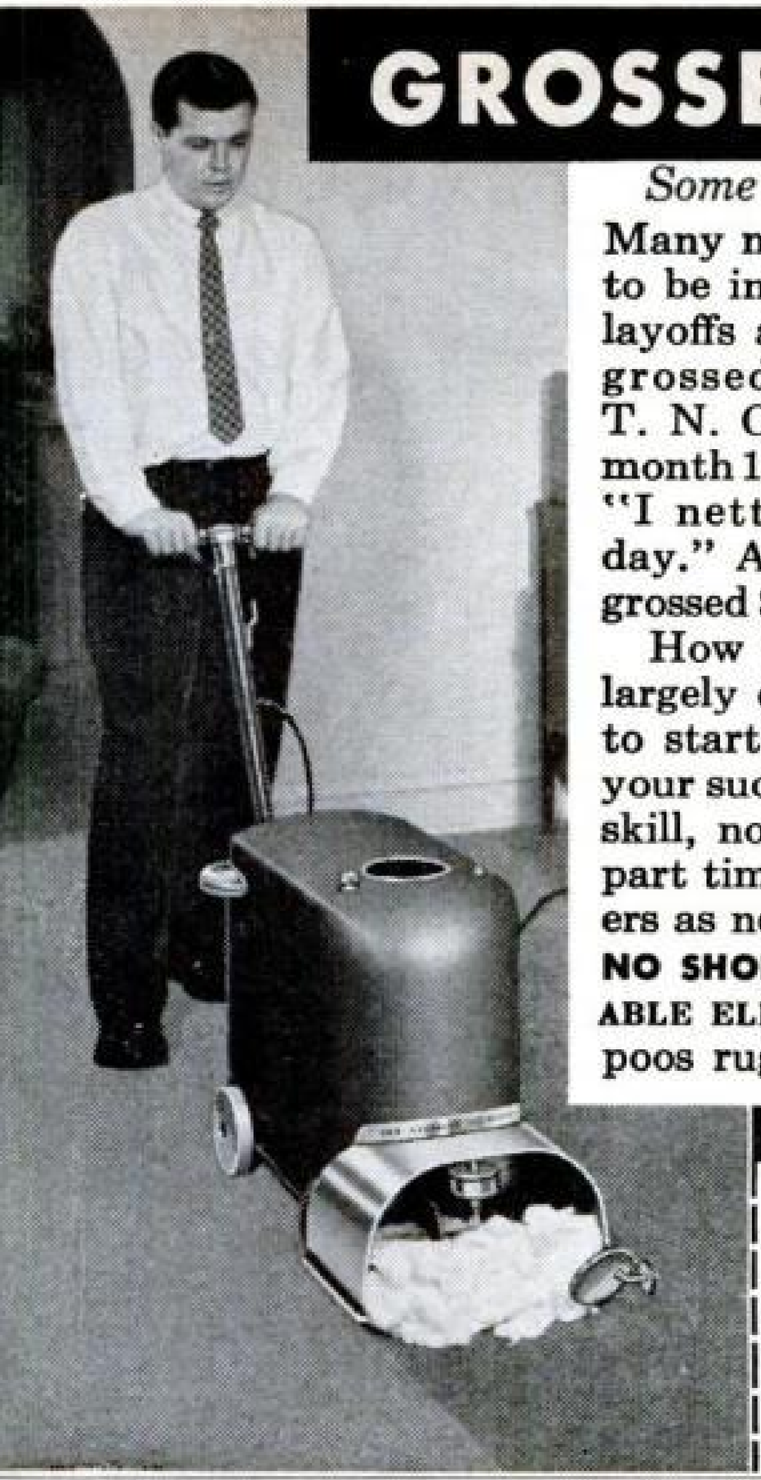

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Detroit report...

LOOK FOR A COMEBACK IN ALUMINUM ENGINES. Chevy is said to be working on a 400-cu.-in. aluminum V-8. Differences between it and previous (unsuccessful) aluminum jobs: It has a die-cast block and head, and (most important) does without the usual cast-iron cylinder liners. Piston rings rub directly against the aluminum cylinder bores. Home for the new mill? Probably Corvette for '67.

Studebaker has made a transistorized ignition system standard equipment on one model, and is offering the same system as optional equipment on all other cars in the line. Charge is $39.50 for the Prestolite-supplied electronic ignition. It was Studebaker that first introduced disk brakes as standard equipment on American cars. Now all companies offer disk brakes in one form or another. The Prestolite system is said to provide longer spark-plug life, better starting, permanent engine tune-up, longer life in distributor parts, better fuel economy.

Olds' front-drive car [see page 63] is being eyed closely by certain automotive suppliers because of its unique parts and components. The car will mean extra business for chain manufacturers since it uses a wide drive chain not found in conventional cars. Several suppliers have been working with Olds on the design of the chain. The four constant-velocity universal joints in the system will also mean a bonanza to suppliers of such components. Saginaw Steering Division of GM will supply the steering gear. A Saginaw engineer says there are no special problems in the front-drive system. All steering components are located ahead of the axle shafts where there is plenty of room.

Every GM car division is getting a crack at bringing out its own low-volume car to reflect the newest engineering and styling work. Corvette was the first. Then came the Riviera. Now Olds is preparing its Holiday front-drive car for 1966, and Cadillac and Pontiac are working on something completely new for '67: way-out styling to furnish snob appeal. Pontiac is thought to be working on a car about the size of the Mustang, with broad expanses of sheet metal. The wide roof panel flows straight back to the rear bumper and stretches clear across from the extreme outside of one rear fender to the other. The hood will be low and wide, flowing into big humps at each side where the wheel wells protrude. The car will be ultra-low. Not too much is known about the Cadillac yet, but it, too, will be very low, with doors cut well into the roof panel to ease entry and exit problems.

Look for radial-ply tires to be used extensively on '66 cars. Several U. S. rubber firms have just put them into production—the first time in this country for passenger-car use. Up to now, only imported radial-ply tires were available. The Olds Holiday will almost certainly use radial plies on all wheels. They differ from conventional tires in that the tire cords run across the tire from bead to bead, at right angles to the circumference. Conventional cords are set at smaller angles, usually 30-35 degrees.

Benefits of radial-ply construction: no road noise at 70 m.p.h. as in conventional tires; improved directional stability and greater cornering force; longer tread life; better mileage; more tread on the road; improved flotation for driving over soft surfaces. Drawbacks: higher cost; road harshness at low speeds; reduced road clearance because tires deflect about ⅜ inch more than conventional tires; some increase in steering effort.

Fiberglass body panels should find greater use in the future, plastic makers say. Low-volume production cars could be given radical facelifts from year to year with fiberglass parts at low tooling costs. Plastic suppliers are particularly interested in body panels that traditionally have been facelifted—fenders, hoods, deck lids. Car interiors are also getting an increasing share of fiberglass, displacing steel. The interior of the Mustang fastback is a good example: Fiberglass panels in the Mustang are finished to look like either grained vinyl or smooth steel.

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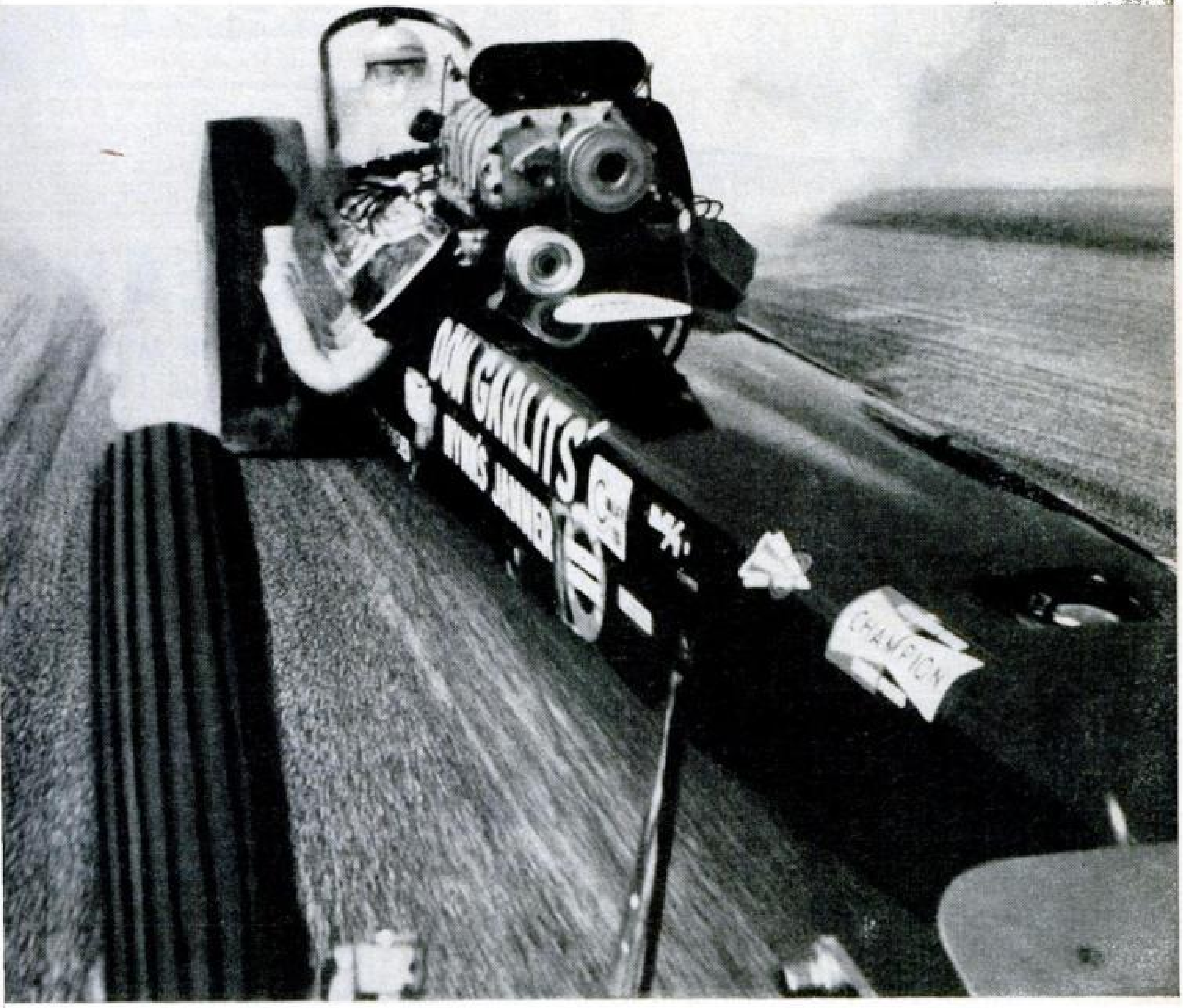

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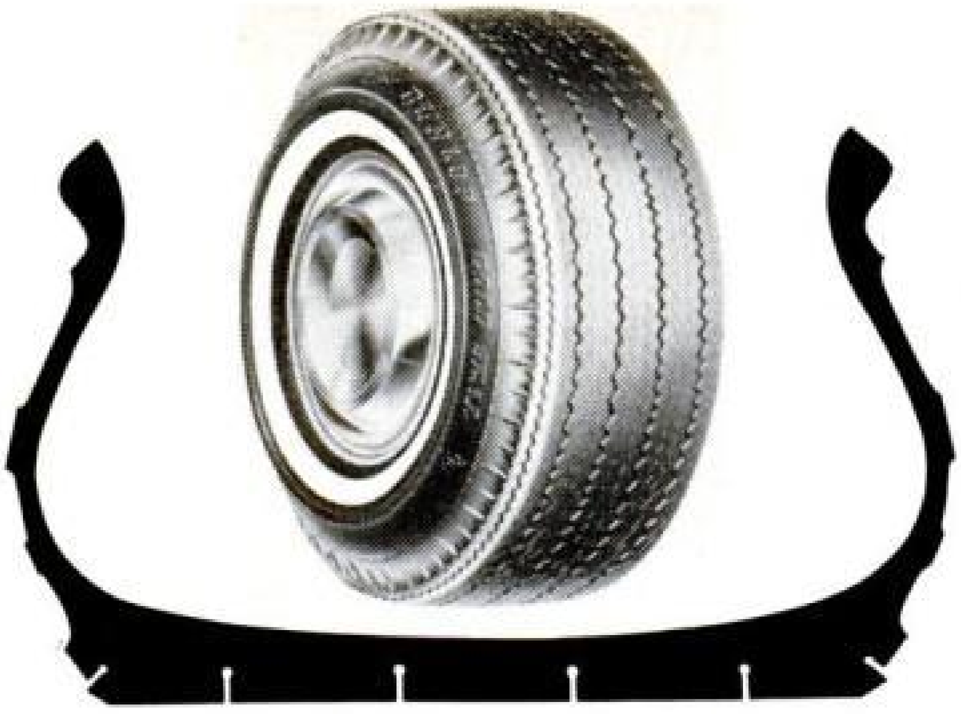

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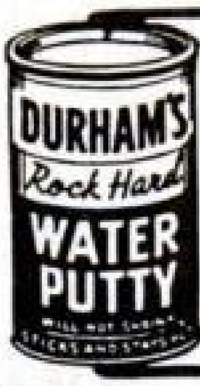

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Popular Science
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NEW OLDS FRONT-WHEEL DRIVE!

Sneak Preview of the '66 Holiday

An Exclusive PS Staff Report

THIS fall, Oldsmobile will introduce a front-wheel-drive car known under the code name Holiday. It will be the first American-built production car with front-wheel drive since the Cord, which disappeared in 1937. It will also be the most radical piece of transportation to come out of Detroit since the Corvair. It's currently the number one subject of arguments among car experts and buffs across the country, although Oldsmobile maintains a strictly "no-comment" attitude.

Front-drive enthusiasts say, "It's about time Detroit admitted the advan-

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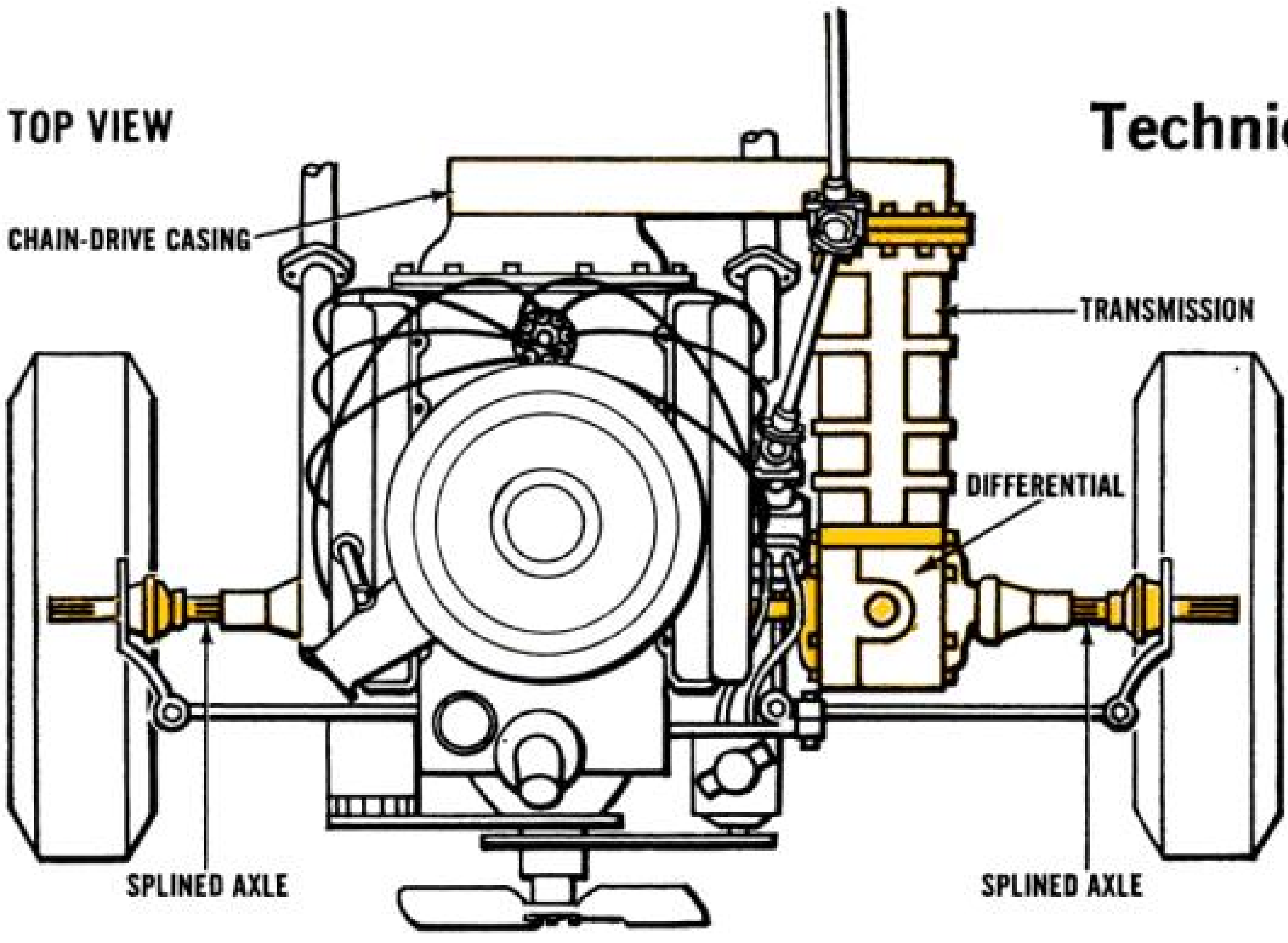
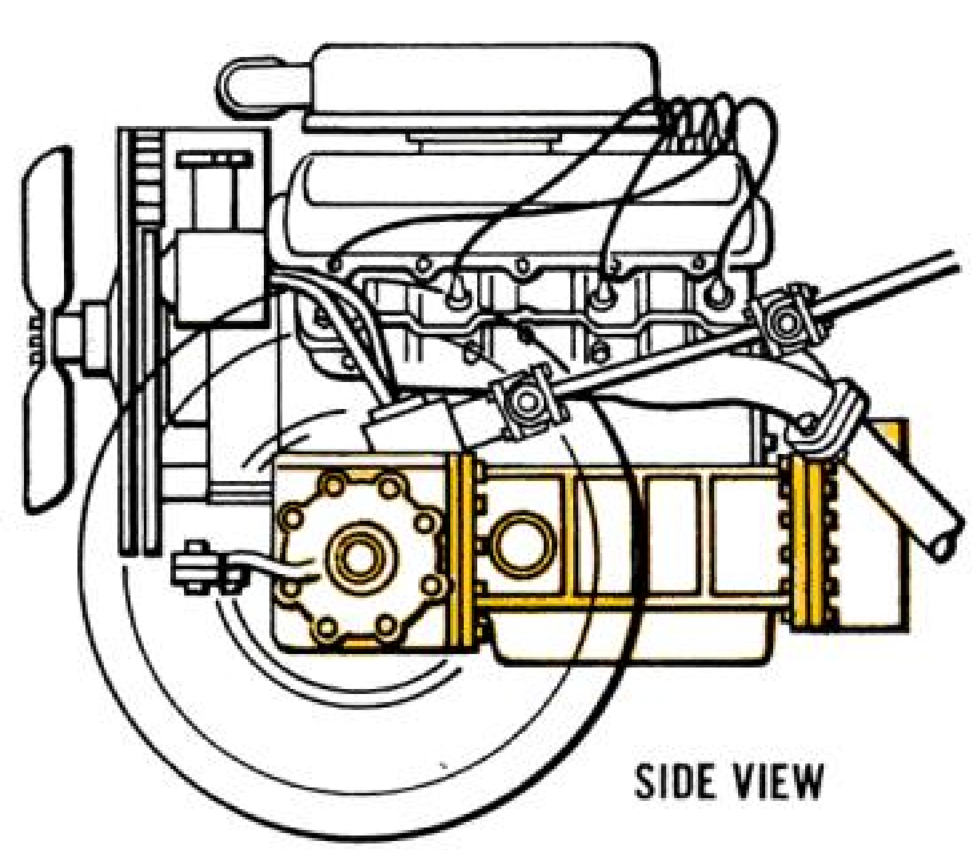
Technical details of the



The V-8 engine (seen from above) is offset to the right to leave sufficient room for both transmission and the splined drive shaft on its left. Such a small offset causes no disturbance in the lateral balance of the car. The cross shaft intersects the oil pan under No. 2 main bearing, which gives a normal engine position and normal front/rear weight distribution.



tages of pulling a car instead of pushing it." European-built front-drives have been popular for years. Makers such as Citroen, Austin, Renault, German Ford, Saab, Lancia, Peugeot, and DKW will produce nearly two million front-drives in 1965.

Expensive flop? Tradition-minded insiders in Detroit are convinced that the Olds experiment will be an expensive flop. "Front-drive offers no real advantages on big, U.S.-style cars—and it costs a lot more money," they say.

Before exploring the pros and cons, let's take a close look at the car on paper. Our information is based on our usually reliable—though unofficial sources.

The Holiday will be competing with luxury "sporty" cars like the Thunderbird. It will share an all-new body with the '66 Riviera. This is a big fastback with long, sloping hood, curved, one-piece door windows, short deck, full-wheel cutouts at the rear.

The front-drive system will consist of Old's premium engine (425 cu. in., 370 hp.), a torque converter with a chain-drive hookup to a three-speed planetary transmission, a differential, and two open half-shafts with constant-velocity universal joints and slip splines.

Here's how all this will be arranged in the cramped engine compartment. The engine will be located as in conventional cars, except that it will be offset to the right of center of the car. Ahead of the engine, in its normal position, is the radiator. Attached to the rear of the engine is the bell-shaped bulb of the torque converter.

A stamped-steel housing is tacked on to the back of the torque converter. The housing extends below the torque converter and over to the left side of the car, where it is also hooked up to the transmission. This housing contains the gears and chain that make up the chain-drive system.

The transmission is connected to the differential on the end opposite from the chain-drive housing. Both transmission and differential are located beside and slightly below the torque-converter combination.

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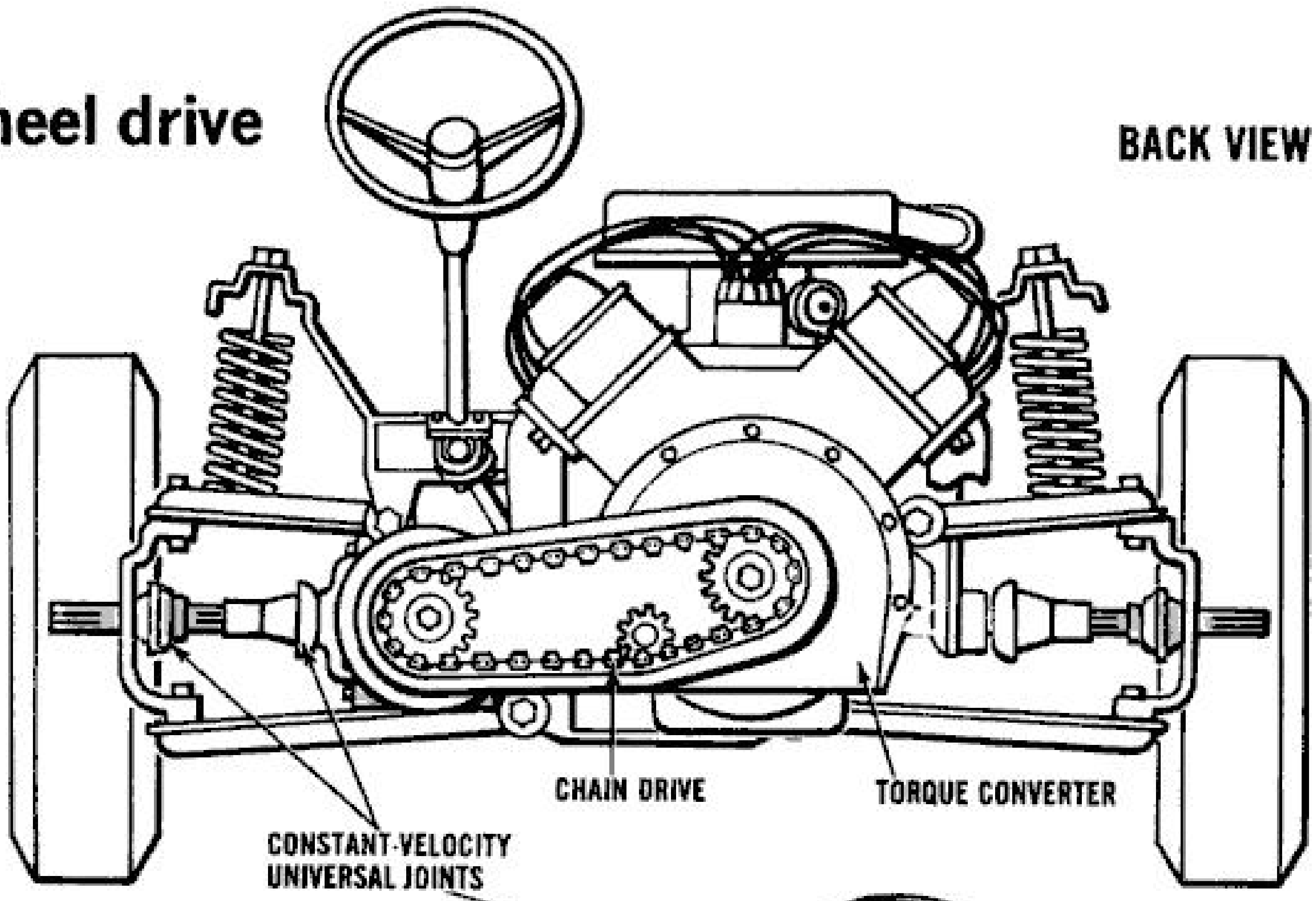
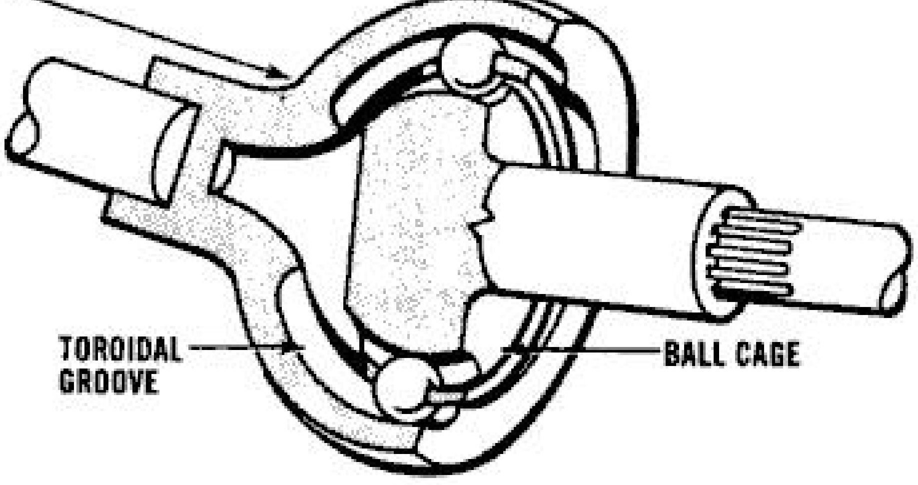
Holiday front-wheel drive



Suspension geometry is similar to that of the full-size Oldsmobiles, but the actual parts are not identical. To leave room for the drive shafts, the coil springs, which are normally fitted in the space between upper and lower control arms, have been moved up on top of the upper control arm. Each drive shaft has two constant-velocity universal joints.



Delivering the power. Driving shafts extend from each side of the differential to the front wheels. But this is not as simple as it sounds. That's because the differential delivers power to the two front wheels in two different ways, one so unusual it's almost startling.

The left front wheel is no problem. Two constant-velocity universal joints are used, one at the differential end of the shaft and one at the left front wheel.

The axle shaft is not a solid piece of metal. It contains a slip spline that permits the axle to change its length as the front wheel moves up and down over bumps.

Routing the same type of axle to the right front wheel posed a problem, since the big engine was directly in the way. Instead of moving the engine, Olds engineers made a tunnel straight through the oil pan. The drive shaft for the right front wheel went through this tunnel.

Some pre-production engines were made this way. As the oil pump was placed so far back, there seemed to be no other way to avoid aeration of the oil. Later, this problem was licked, and now the oil pan has a recess to let that shaft pass under the engine.

The drive shaft is supported by a bearing on the right side of the engine. From here on, there's the same shaft setup as on the left wheel: the slip-spline axle and two constant-velocity universal joints.

Because of the crush for room under the hood, it is expected that the suspension system will have coil springs located on top of the A arms. This is the same arrangement used on many of today's unit-body cars.

Much more hardware is required on the front-drive system than on the front-engine rear-drive setup. That's why the auto industry has gone so slow on front-drive up to now.

Those costly extra parts. Here are the extra parts you'll have to pay for: two slip-spline axle shafts; four constant-velocity universal joints; silent chain-drive system; special steering and suspension systems.

The only major saving comes about from the elimination of the long, jointed drive shaft used on conventional cars.

The arrangement of under-hood components will not cause any real trouble for optional-equipment parts such as air-conditioning units. Olds is expected to make room for them up front, too.

Price tag of the car is in the $4,500 to $5,000 range, or about the same as the

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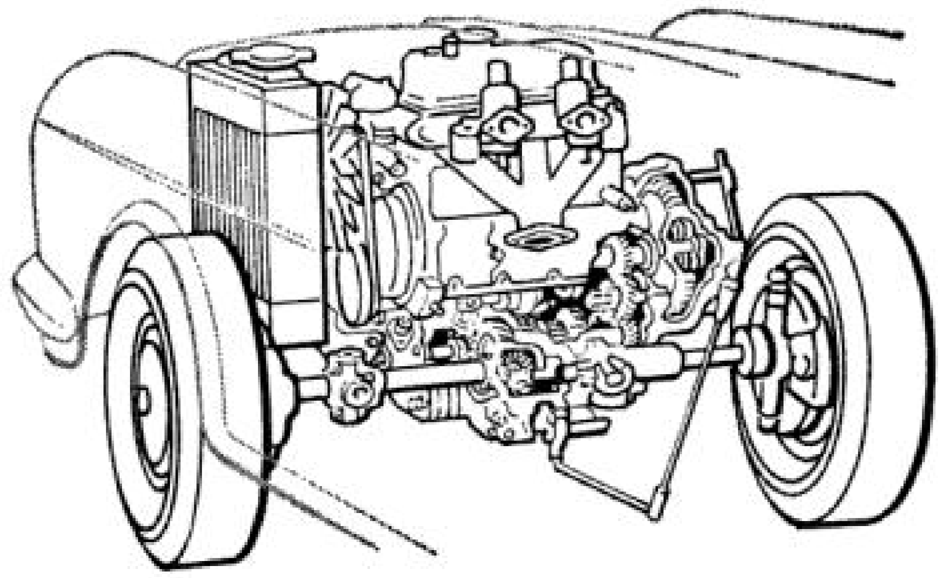
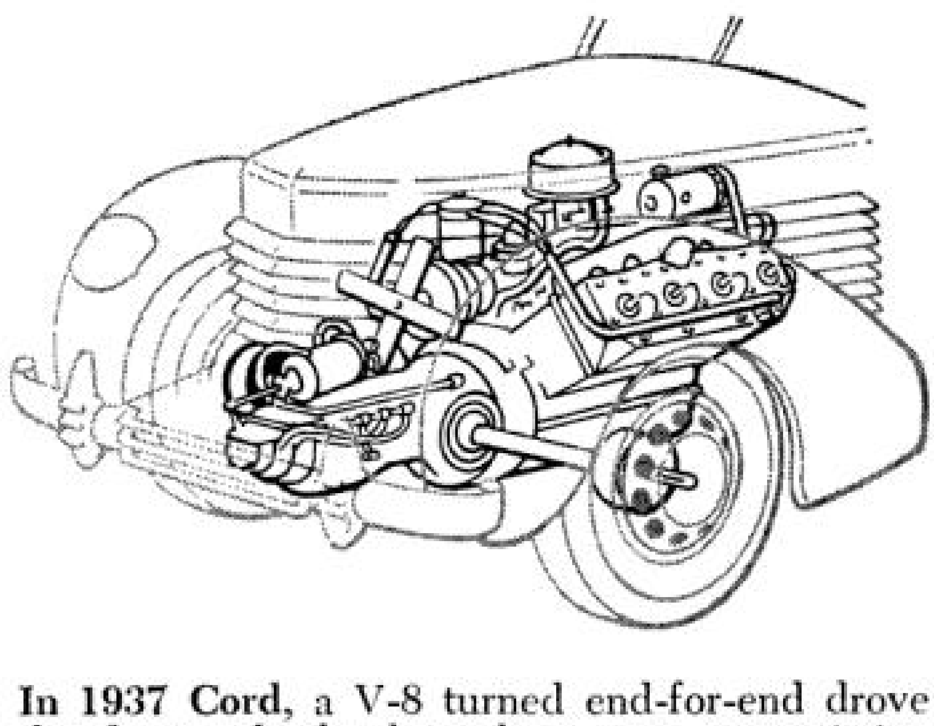
Cutaway views of two other front-drive cars



In the MG 1100 the engine sits across the car and drives the front wheels via an outrigger clutch and a gearbox located inside the oil pan.



In 1937 Cord, a V-8 turned end-for-end drove the front wheels through a nose transmission and a between-wheels differential.

Thunderbird. On the outside, the car is a little bigger than the T-Bird, but very close to the Riviera. Overall length will be 210 inches and wheelbase about 119. It will weigh just about 100 pounds over the two-ton mark, slightly heavier than the Riviera.

Since the rear wheels do not drive the car, Olds will use a simple bar axle at the rear. The "dead" rear axle may have a "drop" in it to provide more room for rear-seat passengers and more luggage space.

Pros and cons. So much for the mechanical differences. What about the arguments pro and con?

The detractors say:

- Front-drive gives poor traction, especially on hills when roads are slick.
- It causes excessive front-tire wear.
- It puts too much weight on the front, making power steering mandatory.
- Its only advantage is flat floors, which give more room inside—a boon in small cars, but not needed in big ones.
- It's dangerous because drivers are accustomed to the handling characteristics of rear-drive cars.
- The clincher: It costs too much for what you get.

Front-drive advocates are vehement in rejecting these criticisms:

- Test drivers with actual experience in the car say it will climb slippery hills with ease. With 60 percent of the weight on the front wheels, there's plenty of traction.
- Admittedly, the front tires wear faster, but this is balanced by reduced wear on the rear tires. You simply rotate the tires regularly.
- Power steering would be standard, these days, on a car of the Holiday's size and price anyway, so this requirement is no real drawback.
- That front-drive cars are dangerous is pure nonsense. Actually they're safer.
- The cost to Olds has been estimated at about $100 more than with a similar conventional car.

Driving with front-drive. The difference between front-drive and conventional drive on a typical city street or highway is almost unnoticeable. The big differences come on rough roads and during hard turning maneuvers, but drivers soon adjust.

Driven front wheels have a much stronger self-centering tendency than the front wheels of a conventional car. This gives the front-drive car higher directional stability, and a front-heavy, front-drive car is an inherent understeerer (a handling characteristic giving greatest stability in cornering). On some cars, understeer is increased when power is applied, and diminished when the throttle is closed. This behavior pattern exists on both front- and rear-drive cars.

But when the front wheels of a rear-drive car run wide, the car will—in extreme cases—plow straight on regardless

[*Continued on page* **207**]

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Famous Four-Banger Offy Is Tendered Last Rites

This is the third of four articles on the Indianapolis 500 by Popular Science's popular columnist, Smokey Yunick, ace auto mechanic and veteran race-car builder. In it he tells of the eclipse of the most famous racing engine of all time, the Offenhauser.

By Smokey Yunick

IT'S pretty sad when you think about it. One of the finest racing engines ever produced appears to be on its last legs. Join me in final rites for the Offenhauser.

Last month I promised to tell you what competition Ford's double-overhead-cam V-8 engine would have in this year's Indianapolis 500 race. It won't have much. Lou Meyer, who builds the Offies—and is the sole retail source for the Ford engine as well—hasn't sold a single Offy for this race. That doesn't mean there won't be Offies (also known as Meyer-Drakes) on the track—there are plenty of them still around.

The big switch. But the big names in racing, both owners and drivers, are going for the Fords. That includes A. J. Foyt of Houston, who won both the 1961 and 1964 events with an Offy. Moreover, Foyt's racer will mount the engine in the rear, like the British-built Ford Lotuses entered in '63 and '64.

Parnelli Jones, from Torrance, Calif., who drove an Offy to victory two years ago, will have a car almost a duplicate of Foyt's. Rodger Ward of Indianapolis, who captured the 500 in 1959 and 1962 with—you guessed it—an Offy, will drive a Ford.

Naturally, so will Jimmy Clark, the Scotsman who finished second in a Lotus Ford in 1963, and Dan Gurney, from Costa Mesa, Calif., also in a Lotus, who finished seventh. Both pooped out in Lotuses in 1964.

Ford Motor must have loosened up on its sales of racing engines because my latest count would indicate no less than 17 of them will be entered. I would not be surprised to see all 17 qualify.

The field is limited to 33 cars. I understand that owner Andy Granatelli will enter two of his supercharged Novis (which have never won) with four-wheel drives this year. If Mickey Thompson enters a couple of cars from his shop in Long Beach, Calif., he probably will use engines of his own design on some Chevy blocks left over from 1963.

Down to a dozen? If, say, two European engines should qualify, the Offies starting could number less than a dozen. Bear in mind that nothing but an Offy has won the 500 for the last 18 years. Sad, eh?

I am not saying that the reliable, old, fire-breathing four-banger will not have the devotion of the faithful. Len Sutton of Portland, Ore., who finished second to Ward in '62, will drive an Offy. Owner John Zink of Tulsa will enter a couple. A rookie, Mickey Rupp of Mansfield, Ohio, is committed to an Offy. So are Walt Hansgen and Bob Veith.

But the representation is pretty thin. The reason, of course, is that 'most everybody believes a Ford engine is bound to win. To make the situation even weirder, some three dozen of the 60-odd cars that will try to qualify will be rear-engined. No rear-engine car has ever won the Indianapolis 500.

An Offy *could* win this year. In racing anything is possible. But if you're a gambling man, get at least 1,000:1 odds. The driver often spells the difference between victory and defeat. The driver who is "peaking" on his own performance is a man to watch. An Offy won two years ago only because a man named Jones was so fiercely determined to be first.

Next month I'll tell you what's being done to prevent the fires that last year killed Eddie Sachs and Dave MacDonald.

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LEE OSWALD'S GUILT...

How Science Nailed

Lee Harvey Oswald is shown in Dallas police lineup the day after President Kennedy was shot to death. Cut on his head was received when he resisted arrest.

Here's an expert's report of how modern technology and detective work solved the mystery surrounding the assassination of a President

THE Warren Commission's investigation of President Kennedy's assassination involved the most extensive use of scientific aids in the history of crime detection. Ballistics, fingerprints, handwriting analysis—even neutron analysis—were used by the investigators to establish who the murderer was and how he fired the shots that killed the President.

The task assigned to the commission was stupendous. More than 500 witnesses were questioned. Bullets, shells, documents, fibers, and clothing had to be examined and evaluated. The angle of fire, the speed of the automobile, the wounds suffered by the President and Governor John Connally of Texas became the objects of painstaking analysis.

In spite of this massive job, the commission had one great advantage—the chief suspect, Lee Harvey Oswald, was dead. This enabled the investigators to obtain a great deal of material and information that

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THE WARREN COMMISSION *The members (left to right): Rep. Gerald R. Ford, Rep. Hale Boggs, Sen. Richard Russell, Chief Justice Earl Warren, Sen. John S. Cooper, John J. McCloy, Allen W. Dulles, and J. Lee Rankin, committee counsel.*

Kennedy's Killer

By Dr. LeMoyne Snyder

One of the nation's outstanding experts in the field of legal medicine and a former medicolegal director of the Michigan State Police, Dr. Snyder is both a lawyer and a physician. He has lectured on legal medicine at Harvard Medical College and other leading U.S. medical schools, and is the author of *Homicide Investigation*, a classic text for police and medical examiners.

might not have been available had he lived to face a jury—his wife's testimony, for example.

All the technical evidence considered in the Oswald case is admissible in court, but it is not all equally conclusive in providing proof. Some types of scientific evidence you can almost "hang your hat on"; others you accept with varying degrees of reservation.

I rate as most convincing: fingerprints and palm prints, followed closely by the examination of recovered bullets and fired cartridge cases to determine if they came from certain weapons. Next in order I would place the handwriting analysis of the various cards and documents belonging to Oswald, and finally, tests of the fibers found on the gun and in the bag in which the weapon had been carried. These all point directly to the murderer. But equally important is an analysis of the wounds inflicted upon the President and Governor to determine how many bullets struck

The murder weapon, a 6.5mm Mannlicher-Carcano rifle, is held aloft by a Dallas detective. The commission said Oswald bought the rifle by mail, using an assumed name.

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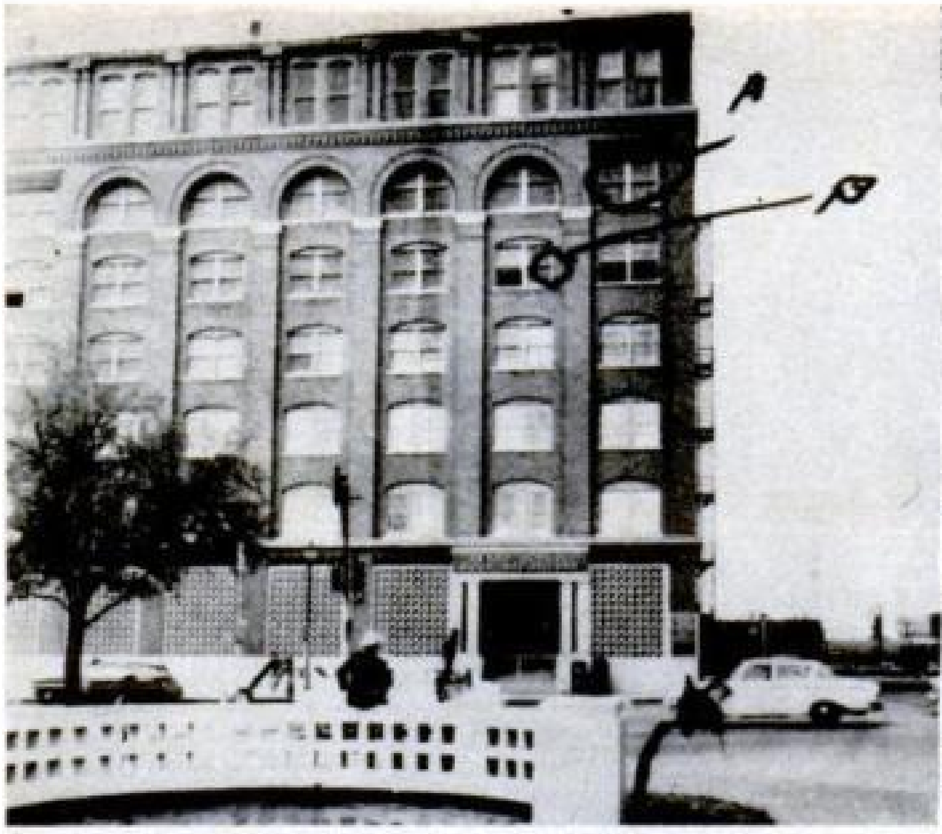
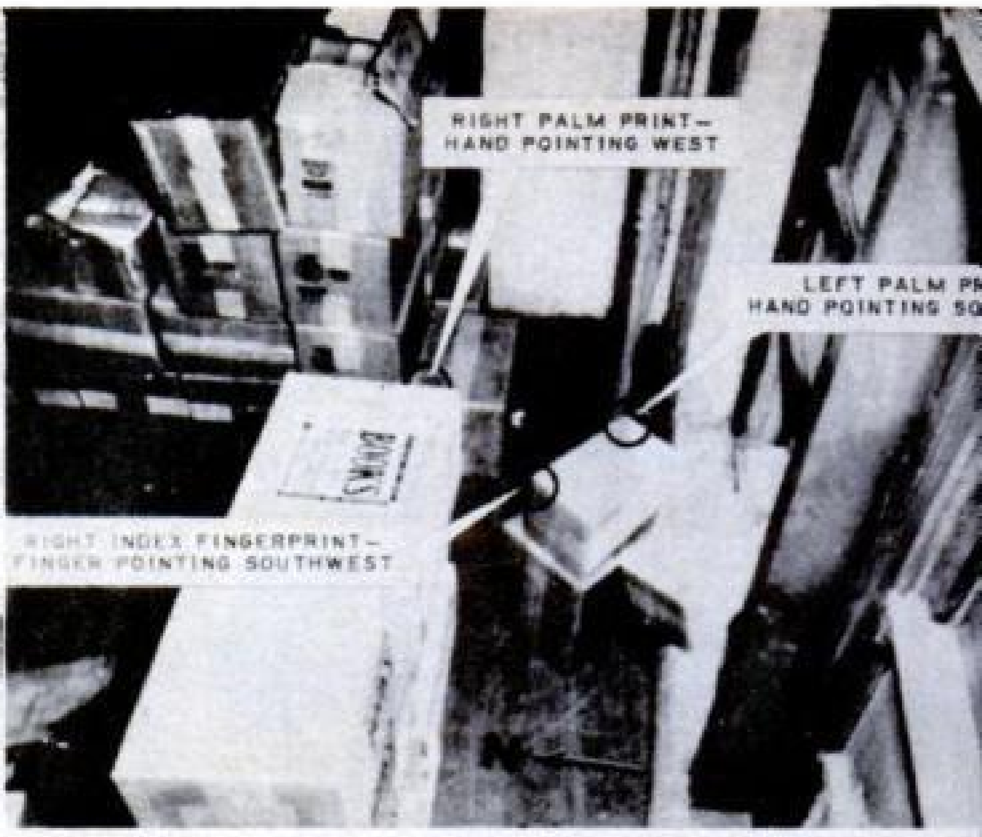


Exhibit 477 shows man standing where Howard L. Brennan was when he saw Oswald. Brennan marked killer's hiding place A, the window he saw workers at, B.



Oswald's prints on cartons near the window from which killer fired convinced commission he positioned himself there to wait for the motorcade to pass.

them and the direction from which they came. Tied in with that was the use of surveying instruments and cameras to determine the angle of fire from the book depository window, the distance the car traveled during the shooting, and the experiments to determine the loss in velocity of the bullets after penetrating human tissue.

Following his arrest, Oswald denied owning a rifle. When later his wife, Marina, said that he did and led police to the garage where it had been kept rolled in a blanket, the rifle was missing. It had been purchased by mail by an "A. Hidell," and sent to P. O. Box 2915, Dallas, Tex.

The alias "A. Hidell," or slight variations, was used by Oswald on several occasions. It was used on cards and posters when Oswald was active in the Fair Play for Cuba Committee in New Orleans, on a spurious U. S. Marine Corps certificate of service found in Oswald's wallet, on a draft card and other documents. Oswald once got his wife to sign a smallpox vaccination certificate "Dr. A. J. Hideel." All the signatures were identified as Oswald's, except the one signed by his wife.

Photos and fibers. Police also found a photograph of Oswald holding a rifle and wearing a revolver. While it is impossible to state that the rifle is the one used in the assassination, no difference can be detected between it and the one found in the depository, except for the sling. It was also established scientifically that this photo had been taken with Oswald's camera by his wife.

In addition, cloth fibers were found on the murder weapon. These were similar to the material in the shirt Oswald wore at the time of the killing. A palm print—identified as Oswald's—was also found on the underside of the barrel. The weapon bore the same serial number as the records of the sporting-goods dealer who sold it.

As the presidential motorcade passed, two workmen were watching through open windows on the fifth floor of the depository, directly beneath the window where two eyewitnesses saw a man firing a rifle. The discharges made very loud reports and dislodged dust and other material, which fell from the ceiling on one of the fifth-floor spectators. They said that they could hear the bolt action of the rifle as it was reloaded after each shot and could also hear the ejected shell cases when they struck the floor above them. (Three empty shells were later found in front of the sixth-floor window.) The commission visited the fifth floor to verify the witnesses' accounts. When a

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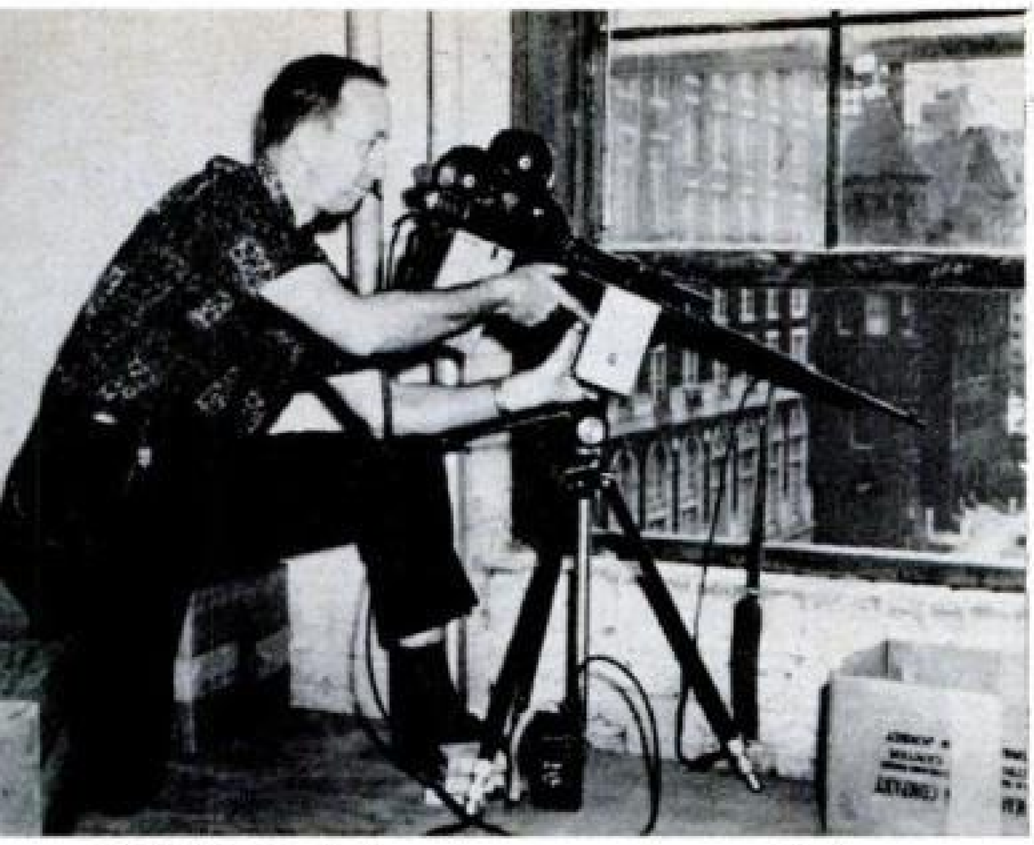
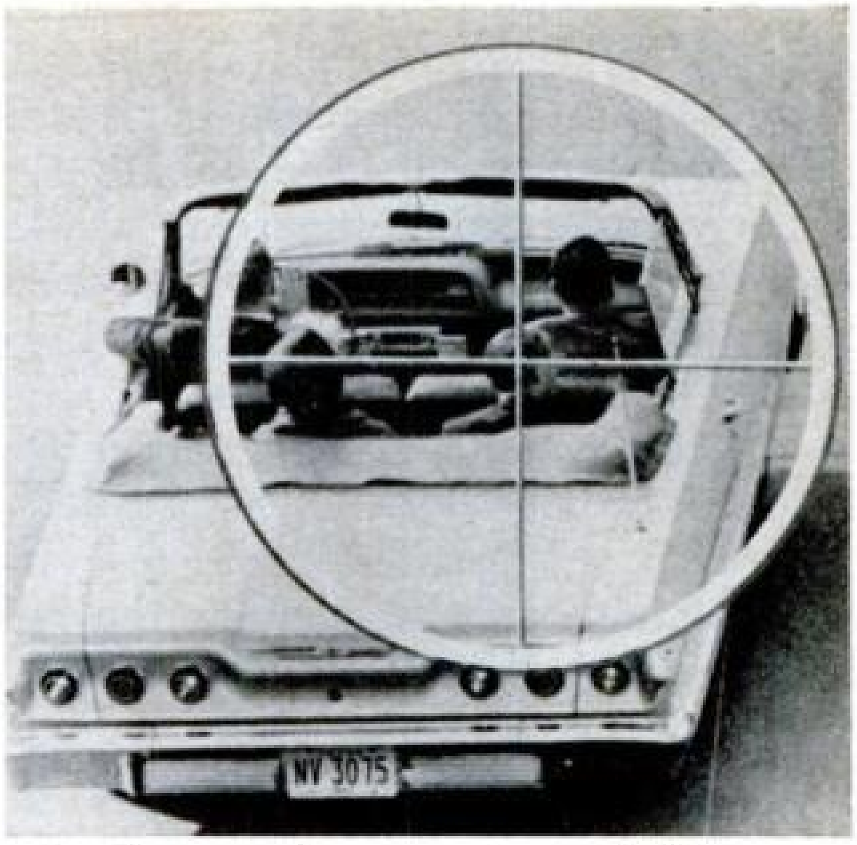


Exhibit 887 shows reenactment of the assassination. Camera was focused through telescopic sight of the murder weapon to recreate what the assassin saw.



Here's the way the assassin probably saw President Kennedy and Governor Connally from his perch on the sixth floor of the book depository where he worked.

rifle above them was "fired," they distinctly heard the bolt action and the empty shells striking the floor.

Fingerprints and palm prints. A bag made of brown wrapping paper and tape—materials identical to those used in the depository's shipping department—was found close to the sixth-floor window. Oswald had the bag with him the morning of Nov. 22, 1963, when he left his wife's home in Irving, Tex. He told a fellow employee, Buel W. Frazier, who drove him to work, that the bag contained curtain rods. Fingerprint experts recovered a print of Oswald's left index finger and his right palm print from the bag. The palm print was at the bottom, which indicated that the package held objects heavier than curtain rods. Some fibers found inside the bag were similar to those taken from the blanket the rifle had been wrapped in. But there were too few for a fiber expert to be positive they came from that source. However, the commission was convinced Oswald carried the disassembled rifle in the bag.

Oswald's palm print was found on the underside of the rifle barrel. It could have been placed there only when the gun was disassembled, and leaves no doubt that Oswald brought the gun in the bag, set up some cartons, and fired the weapon. Oswald's fingerprints were also found on the cartons stacked around the window from which the shots came.

A spectator along the route of the motorcade, Abraham Zapruder, took movies of the presidential car at the time the shots were fired. These films made it possible to establish with great precision where the car was when the shots were fired, the distance between shots, and the elapsed time. The Zapruder camera operated at a speed of 18.3 frames per second. By counting the number of frames between events, the elapsed time could be determined, as well as the position of the car.

Angle of fire. During a reenactment, a camera was mounted on the murder weapon and pictures taken through its telescopic sight. This allowed experts to determine the horizontal angle of fire and the relative positions of the victims in the line of sight. They also measured the exact distance from the rifle to the victims at the time they were shot.

Allowance had to be made for a slight slope downward of the street and it was found that a deflection from the horizontal of the rifle of slightly more than 17 degrees would account for the first bullet passing through the President's neck and striking the Governor in the right shoulder, as actually occurred. By comparing all the motion pictures it was deter-

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Urheberrechtlich geschütztes Material

mined that the President received the head wound when he was 265.3 feet from the rifle in the sixth-floor window and that the angle of declination was slightly more than 15 degrees. This evidence established beyond question that the bullets came from the rear of the car and ruled out any possibility that the shots could have come from a triple overpass in front of the motorcade.

One of the greatest problems facing the commission was whether the bullet that pierced the President's neck also wounded Governor Connally, who was riding in the jump seat directly in front of the President. After a bullet travels through tissue, it tends to become "upset," which means that the main axis of the bullet is no longer parallel to its direction of flight. If it strikes another person, the side as well as the nose of the bullet comes in contact with the skin at the point of entrance, producing an elongated wound instead of a neat, round hole.

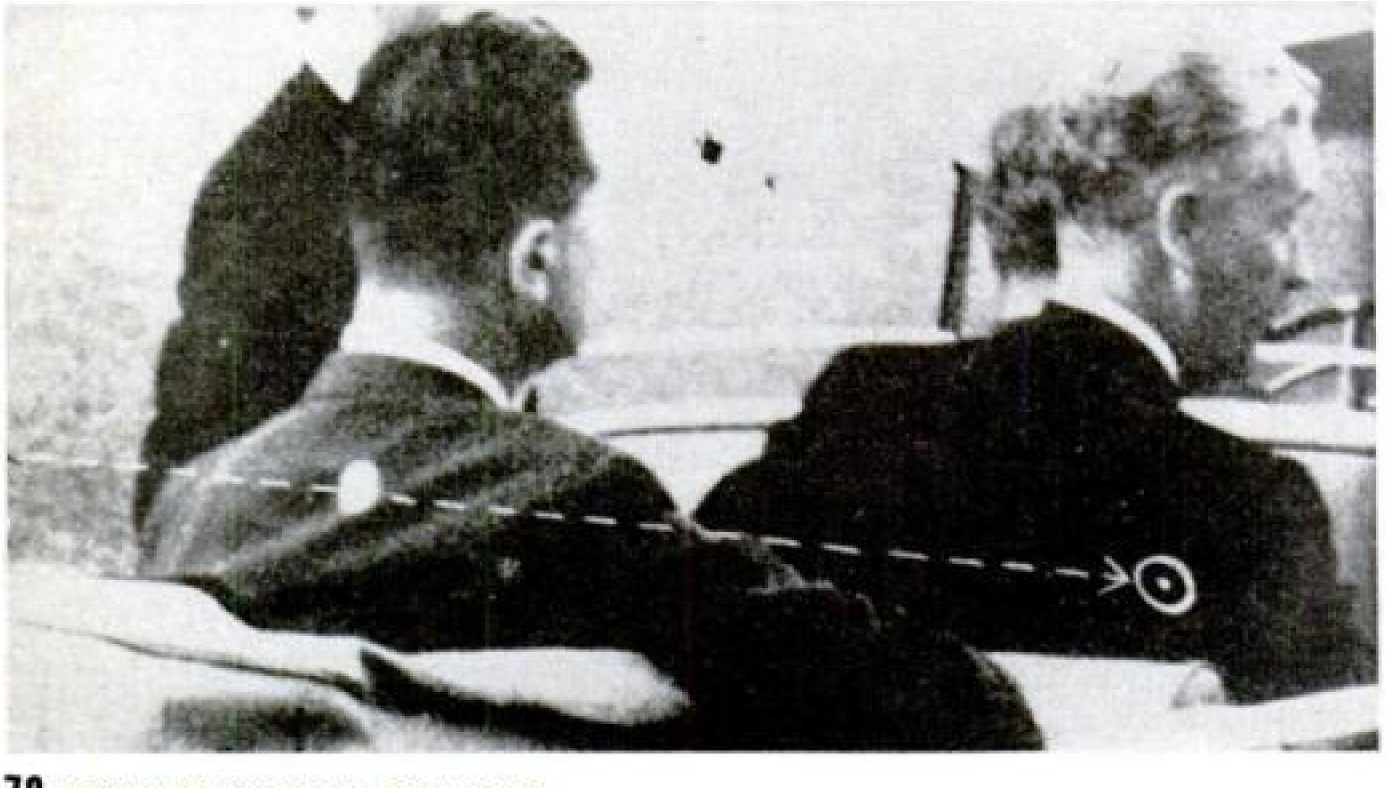
The Governor's "ragged wound." The surgeons who operated on Governor Connally reported that the entry wound in his back was over an inch long in its longest diameter. The "wound of exit was a ragged wound approximately five centimeters (about two inches) in its greatest diameter." As the diameter of the ammunition was only about ¼ inch, this indicates to me beyond doubt that the bullet had already penetrated the President's neck before entering the Governor's back. Connally was hit when he was turned slightly to the right, so that the bullet took a slightly downward course and emerged below the right nipple. By this time its velocity was nearly spent, but it still had enough momentum to penetrate his right wrist and left thigh.

The paraffin test. Several hours after Oswald was taken into custody, Dallas police made a paraffin test on his hands and right cheek. It was positive on both hands, negative on the cheek. The test apparently was made immediately after taking fingerprints and palm prints.

The paraffin (dermal nitrate) test was first demonstrated in this country 32 years ago, and I was present at that demonstration. I have used it often with good results. For a variety of reasons, the test failed to furnish conclusive evidence in the Oswald case, but I still regard it as a valuable investigative tool.

When properly performed, the paraffin is not brushed or poured on the suspect's skin, but meticulously applied drop by drop from a height of several inches. After cooling, the cast is removed and by a slow and painstaking process a reagent is applied that will produce a blue reaction in the presence of nitrates. A nitrate from any source will produce a certain amount of blue reaction, but a trained scientist can detect immediately whether the nitrate is due to unburned powder particles or to some other source. A negative reaction to powder particles should never be interpreted to demonstrate that the suspect did not fire a weapon.

Oswald had discharged two firearms for a total of at least seven shots (includ-



Two FBI agents, with builds similar to those of the victims, helped establish distances at which bullets struck. Chalk marks were sighted through the same scope the murderer looked through and the cars were then put in positions determined from studying movie films of the assassination.

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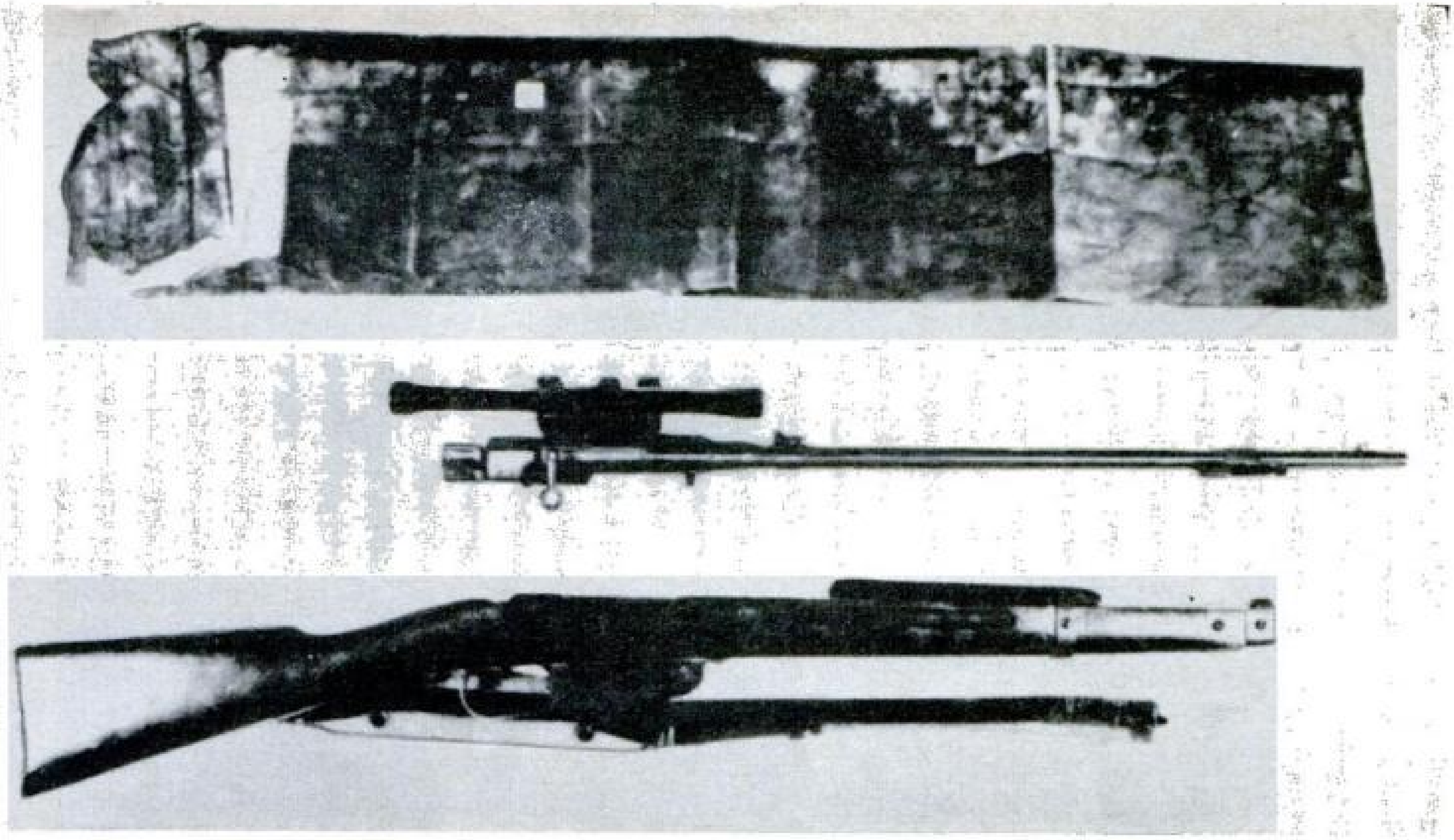

Lee Harvey Oswald's fingerprint and palm print were found on the paper bag (top) in which he is believed to have carried the disassembled weapon (bottom) from his wife's home to the fateful window.

ing the four revolver bullets that killed Officer J. D. Tippit) about two hours before he was in police custody. A properly conducted test might have been extremely helpful. But the results of the test conducted several hours later in an office instead of a laboratory—with Oswald's hands probably contaminated with ink from fingerprinting—deserves little credence, and I believe the commission acted wisely in rejecting the whole thing.

They saw it happen. At least two eyewitnesses saw Oswald fire the shots. One was Howard L. Brennan.

Congressman Gerald R. Ford, a commission member, wrote in a magazine article that Brennan was the most important witness to appear before the panel. Sitting on a wall opposite the depository, he had noticed Oswald standing in the window a few minutes before the motorcade arrived. He also saw two men at the windows below and later positively identified them. Brennan testified that although he saw most of the rifle, he failed to notice the scope sight. After hearing the first shot, he looked up and saw the man with the rifle fire again. A few moments later Brennan described the man to police.

But at a lineup that evening, Brennan was unable to positively identify Oswald. Brennan later told the commission that he could have, but was afraid to do so because he feared the shooting was part of a Communist plot that would have endangered him and his wife.

The commission's finding that three shots were fired within a few seconds posed another dilemma. If Oswald, a trained marksman firing a high-powered rifle with a scope sight with deadly accuracy, put two bullets into the President, only inches apart, how did he miss the automobile completely with the third?

The mystery shot. In every major homicide investigation, it seems that there is always some important evidence that doesn't quite fit the picture and this was no exception. The commission explored various theories in an attempt to account for the third shot, but it is still a mystery.

However, never was such an array of scientific and investigative talent concentrated on a problem as in this case. Their findings led to only one possible conclusion: Lee Harvey Oswald was the assassin and he acted alone. ■ ■

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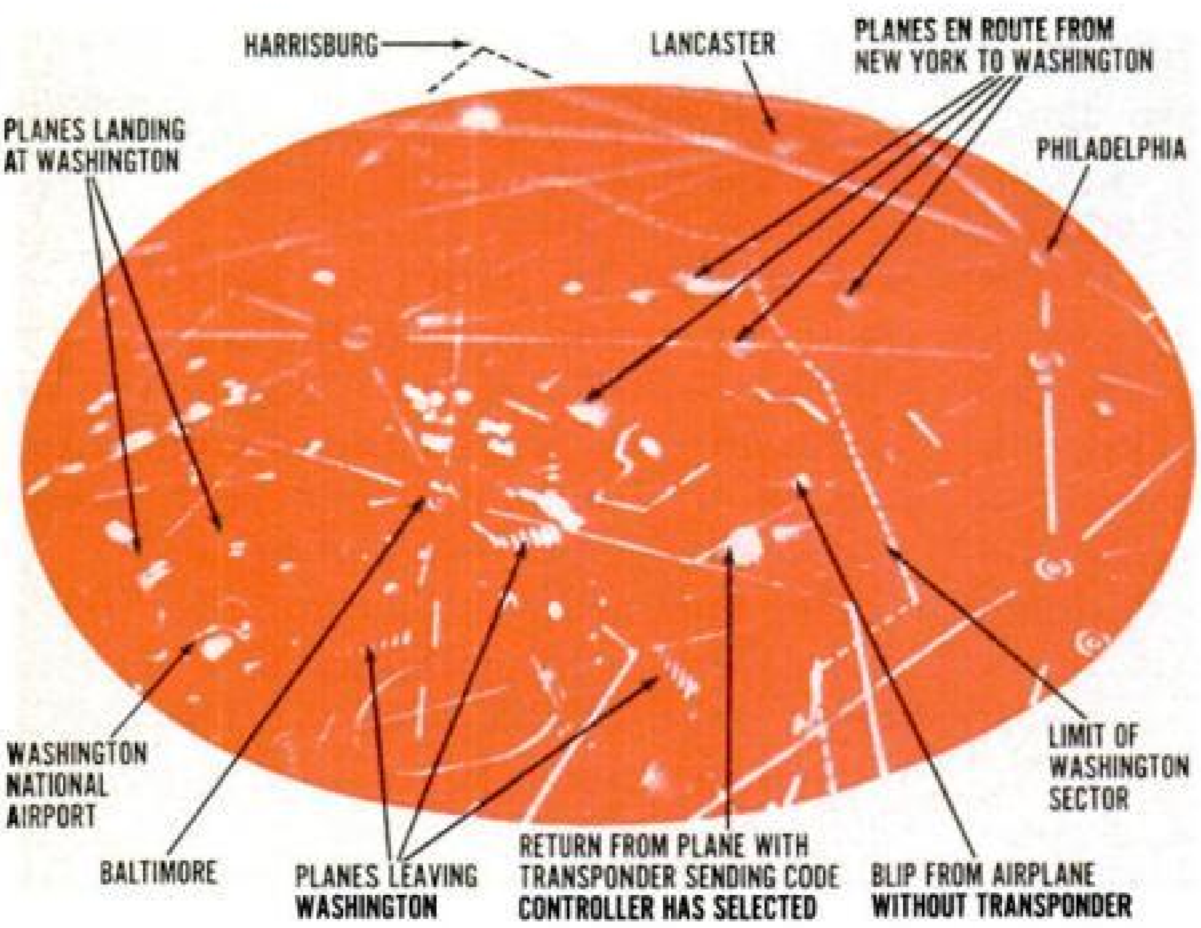

Radar display seen by ground controller shows key aspects of new air-traffic system. Display (interpreted at left) is actually a TV tube repeating part of radar screen with symbols superimposed; circles are radio range stations with airways connecting them. Planes appear as slash marks each time radar beam swings around. Many planes now carry transponders, which send coded return signals. Controller sets display to show some codes as double slashes, to concentrate on specific flights.

Brooklyn street scene after this United DC-8 collided with TWA Constellation, killing 134 in aviation's worst accident. ►

New Radar Cuts Hazard

Soon you'll fly more safely thanks to an improved air-traffic-control network

By Phil Geraci

AT 10:32 a.m. on Dec. 16, 1960, a ground controller at New York's La Guardia Airport saw two blips on a radar scope come together over Staten Island. He had no way of knowing if both planes were at the same altitude. But one fell away in a right

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# of Mid-Air Collisions

hook and disappeared. The other continued across Brooklyn until it, too, disappeared.

The pilot of a United Airlines DC-8 jet bound from Chicago to Idlewild (now John F. Kennedy International Airport) had failed to turn into a holding pattern centered on Preston, N.J. With 77 passengers and a crew of seven aboard, he collided in the snowy sky with a TWA Super Constellation out of Columbus, Ohio, that was just leaving a holding pattern over Linden, N.J., having been cleared to land at La Guardia.

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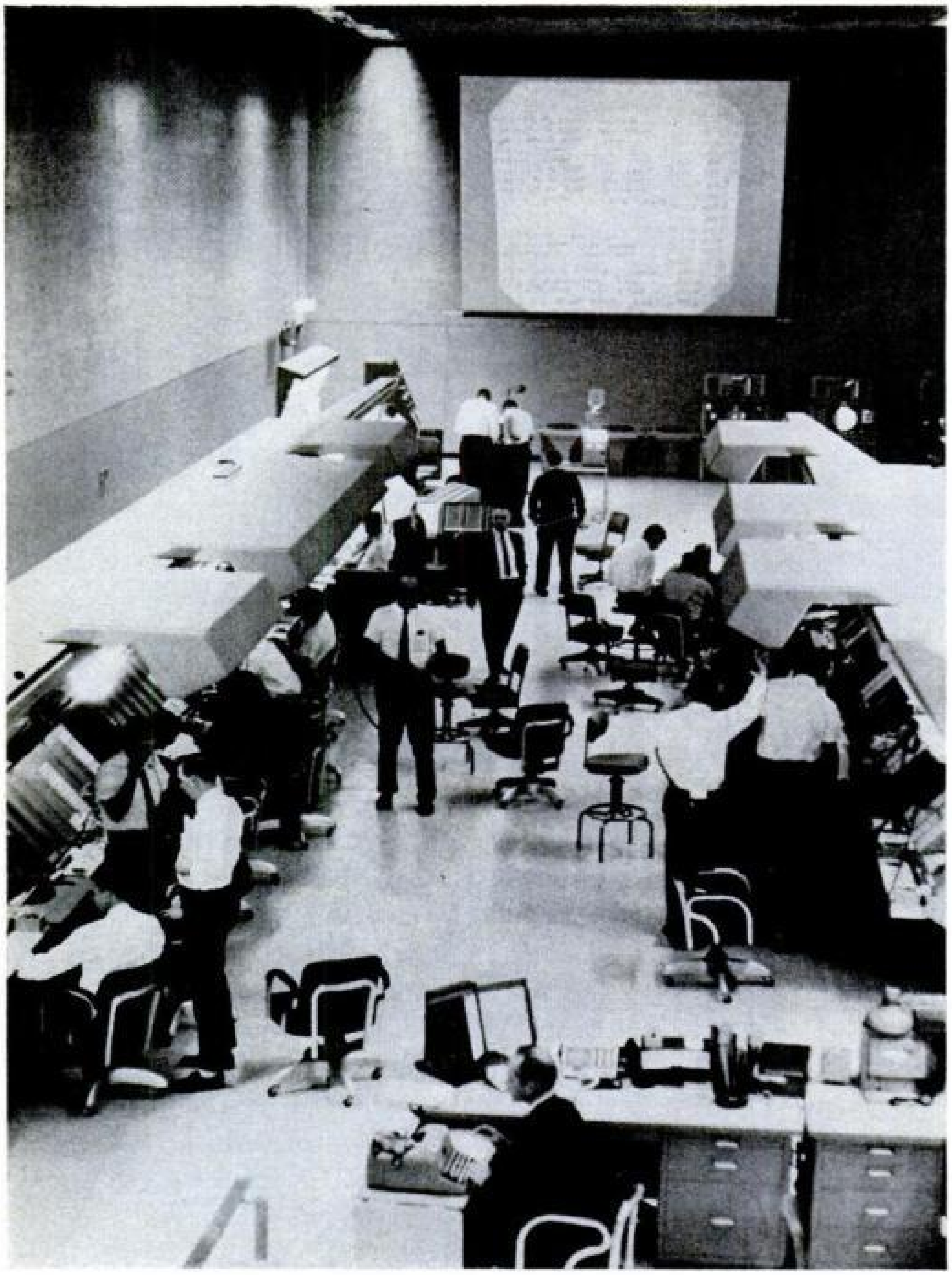
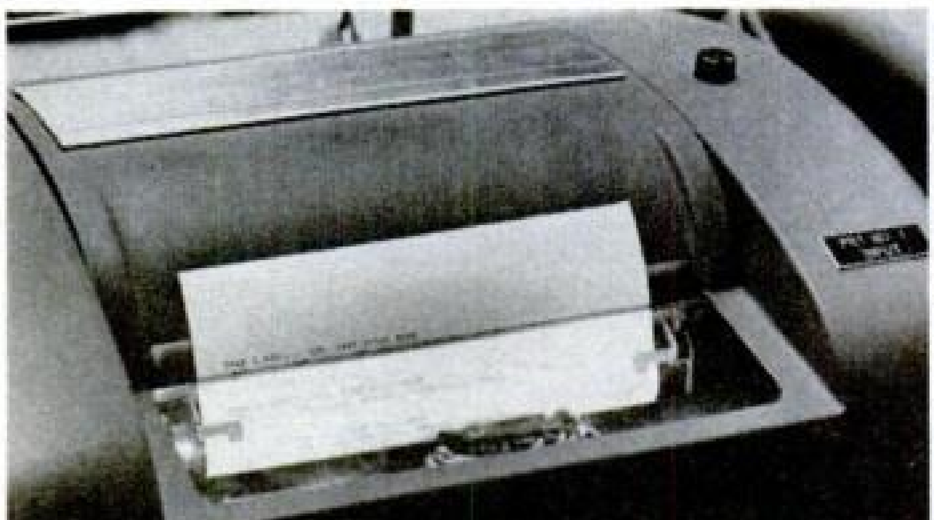


How flights are handled at FAA control center

"Traffic cops" of the airways are ground controllers in 21 Federal Aviation Agency centers that cover the nation. Washington, D.C., center is shown here. Clustered around controllers at radar screens are communications men and coordinators who follow flights "handed off" from one controller to another; each controller handles a portion of the sector, or planes at specific altitudes. When a plane takes off, pilot's flight plan is recorded as a "flight-progress strip" placed in one of the sloping racks before a controller. When controller gets word by radio that plane is entering his area, he notes time on flight strip, then tracks plane, contacting pilot and next controller who will handle flight. Controllers hand off planes to each other, to adjacent control centers, or to approach controllers at airports. Big screen at rear shows data on weather and navigation aids.

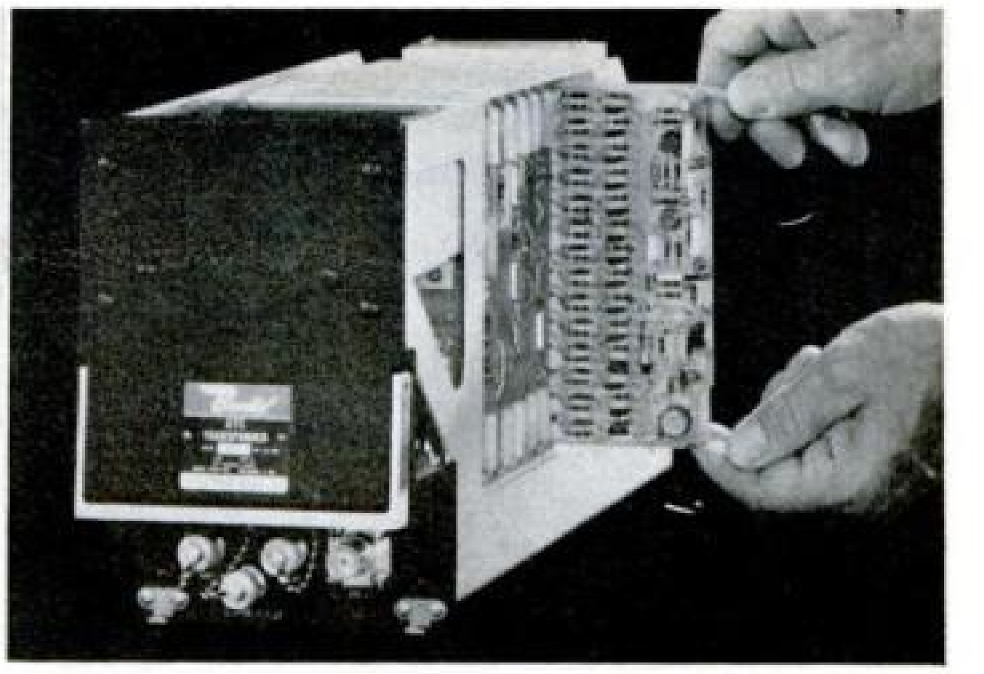


Flight-progress strips come in by teletype from centers equipped with computers to sort out flight destinations and figure flight times. Other flight plans are transmitted by radio.

Controller handles four to six planes at a time, moving plastic "shrimp boats" on scope for identification. Current and upcoming flight-progress strips are in sloping racks.

Urheberrechtlich geschütztes Material

Cockpit control box enables pilot to dial a code that will be signalled automatically to control center when radar pulse is received, telling controllers what the plane is doing.



Actual transponder is carried in plane's electronic-equipment rack, connected to control box shown at left. Transponders are installed in most commercial, all military planes.

Thirty-nine passengers and a crew of five were on the Constellation.

The collision was the worst accident in aviation history. The Constellation fell on Staten Island. Moments later the DC-8 hit a church in the Park Slope section of Brooklyn, starting a seven-alarm fire that destroyed 10 brownstone houses, several shops, and a funeral home. Everyone aboard the two planes died, and six people on the ground were killed in the Brooklyn crash, bringing the death toll to 134.

That was four years ago—four years in which, hopefully, progress could be made in making air collisions impossible. Could such an accident happen today?

There's a slight chance that it *could* still happen. In fact, it has been speculated that the crash of an Eastern Airlines DC-7B off New York on Feb. 9, as it was taking off from Kennedy with 84 aboard, resulted from a near-collision when the DC-7B pilot turned to avoid hitting an incoming Pan American 707 jet, and lost control of his plane.

However, there's very real hope that in the near future collisions will be virtually impossible—because of a new system being installed in the nation's air-traffic-control network and in the airliners themselves.

The black box. Heart of the system is the transponder, or radar beacon, a black box now carried in the electronic-equipment rack of almost every commercial airplane. The device is a descendant of the World War II "IFF" (Identification Friend or Foe), a gadget carried by fighters and bombers to signal in secret code to radar operators on the ground that the blip on the scope was not an enemy plane.

Today's transponders have come a long way from the simple devices of World War II. They are the result of a long search by the Federal Aviation Agency for a system that would tell ground controllers more about the blips on their radar scopes than they knew four years ago.

More information. Ground controllers knew little about the blip except that it *was* an aircraft. They didn't know its altitude, or whether it was climbing, descending, or flying level. They didn't know the identity of the airplane, unless they radioed the pilot for a position report or asked him to circle so the blip could be identified positively. Sometimes a plane failed to show up on the radar screen, or passed unnoticed.

One purpose of the transponder is to strengthen the dot. When the radar beam from the ground antenna sweeps past a transponder-equipped plane, it causes the transponder to respond with a transmitted burst of microwave energy. Since the reply is stronger than a mere reflection, it generates a more readable blip on the screen.

[*Continued on page 214*]

Urheberrechtlich geschütztes Material

You're TOUGHER

George Lawrence's joy ride turned into a plunge toward the churning waters of the whirl-

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Than You Think

pool rapids, just below Niagara Falls.

How much can your body stand? People have fallen chuteless from planes, survived plunges over Niagara Falls—and lived to tell it

By Robert Gannon

LAST May, 16-year-old George Lawrence lost control of his bicycle while riding along the lip of the gorge just downstream from Niagara Falls. He zipped over the edge, fell nearly 10 stories, and landed on a rocky ledge. His injuries: a cut head and sore ribs.

Four years earlier, seven-year-old Rodger Woodward of Niagara Falls, N. Y., was swept over the 161-foot-high Horseshoe Falls after his boat capsized. He survived with only minor cuts and bruises.

In New York City, a patient checked into a hospital complaining of swollen ankles. Before releasing him, doctors removed 258 items from his stomach, including a beer-can opener, 26 keys, and three sets of rosary beads. Nothing was wrong with his ankles.

The careless bicyclist, the youthful capsized boatman, the man who swallows things, all are living proof that people are a lot tougher than most of us think.

Exactly how durable are we? Nobody knows for sure. But our rush toward the moon makes it vital that we find out. How much stress can an astronaut take and still think and act rationally? How long can he go without air, food, or water in an emergency? How much heat, prolonged weightlessness, and crushing re-entry pressure can he endure?

To find some answers, Capt. E. L. Beeding Jr. of Holloman Air Force Base, N. M., strapped himself to a rocket-powered sled, catapulted backward down a 120-foot track, then slammed to a stop. For a moment he was subjected to 82.6 Gs—and weighed almost six tons. Though this high stress lasted

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Urheberrechtlich geschütztes Material

only 1/400 second, Beeding was temporarily blinded. His pulse for a time was completely absent, and he went into deep shock. Nevertheless, he returned to work in less than a week with only a sore back.

Turning on the heat. Future astronauts may also have friction-caused heat to worry about during re-entry. Researchers at the Harvard School of Public Health note that at high humidity, the maximum temperature in which man can work efficiently is about 90 degrees. But the University of Pittsburgh found exceptional men could stand 158 degrees at low humidity for a half hour—two degrees less than temperatures recorded in cockpits of experimental jets.

At Wright-Patterson AF Base, Ohio, they're testing men in ovens. So far, airmen in heavy clothing have withstood 400 degrees for 3½ minutes without braising. A roast beef requires only 325 degrees.

What of internal heat? Physicians for years assumed that a body temperature above 107 or 108 meant inevitable death. Then a student nurse, Sophie Sapala, suffering from undulant fever, signed into Bushwick Hospital in Brooklyn, N. Y. Her temperature: 110, a new record.

Doctors were equally sure that a temperature of less than 79 was fatal. Not so—proved by young Dorothy Stevens of Chicago, who slumped unconscious in the snow, lay there all night in weather of minus-11 degrees. When found frozen the next morning, her eyeballs were crystallized, her heart all but stopped. Doctors rigged a special thermometer to take her low temperature—64.4 degrees. They were astonished when the girl recovered.

In the far north, cold is a constant enemy. "At minus-30 or -40," says a U.S. Air Force survival expert, "a man in regular winter clothing would be lucky to keep alive for a full day." Yet 88 airmen made endurance history a few years ago when they were stranded on the Greenland Ice Cap without special cold-weather clothing. They clung to life in minus-40-degree temperatures for three months before they were rescued.

Air to breathe. Air is something you can't do without. Though pearl divers sometimes stay under water for five or six minutes, the ordinary man can last without air for a maximum of four. The record holder: Californian Robert Forster, who stayed under for 13 minutes 42½ seconds, after breathing oxygen for a half hour before the attempt.

In thin air, most people get woozy at altitudes higher than 8,000 or 10,000 feet. Above that, thinking becomes confused and with any exertion they may pass out. But Peruvian Indians spend their lives as high as 15,000 feet up.

Can others adapt to such a life? Dr. Bruno Balke (USAF) claims they can. In 1958, he climbed 14,000-foot Mt. Evans with a research team. They stayed at high altitudes for six weeks, adapted admirably, and before they left could work as hard there as at sea level.

That men can adapt to thin air is a great help to engineers developing air systems for high-flying planes and space capsules. One approach, successfully implemented in the U-2 program, is "pressure-breathing" of thin, pure oxygen. An air pump capable of holding high cabin pressure at the U-2 altitude—

Found unconscious in the snow, the girl had been lying all night exposed to sub-zero weather. Her heart had all but stopped and her temperature had dropped to 64.4 degrees.

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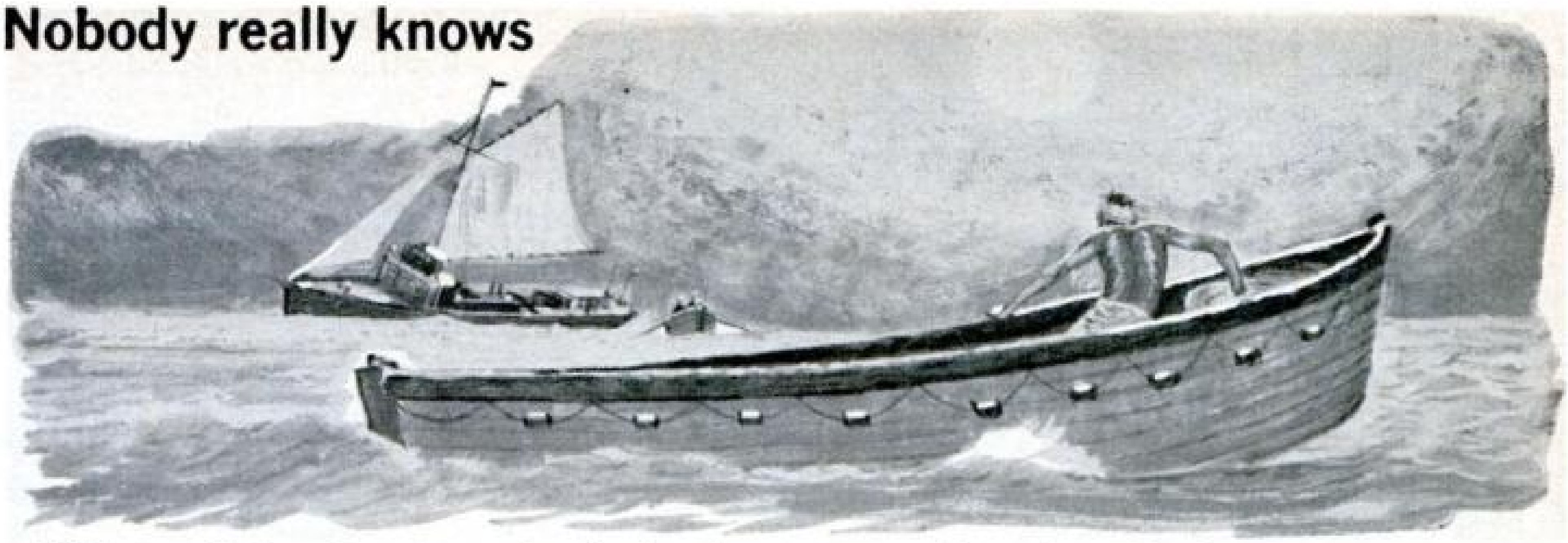
Nobody really knows



Adrift in a lifeboat for 4½ months after his ship went down in the Atlantic, British sailor Poon Lim withstood terrific deprivation. But when rescued, he walked ashore unaided.

well above 70,000 feet—would be prohibitively heavy. So U-2 pilots breathe oxygen for four hours before takeoff (to rid their bodies of nitrogen) and, during the seven-hour flight, breathe oxygen so thin it doesn't unduly expand their lungs. But at that altitude, pressure-breathing saps a man's strength. Upon landing, pilots must be helped from their planes.

How long can you live without food? Our Army survival experts say the average person can last more than a month without a morsel. For proof, consider 315-pound Elaine Johnson. As part of a Los Angeles obesity-research project, she lived on three quarts of water a day, supplemented by two weekly vitamin injections, for 17 weeks. Her poundage dropped to 179, but she was fine.

One of the least understood of man's needs is sleep. Most people function fairly effectively after staying up all night, but after sustained wakefulness, they have hallucinations, suffer blackouts, finally just collapse.

World's record for wakefulness. Randy Gardner, 17, of San Diego stayed awake a first night as a stunt. Then (for a high-school science-fair project), challenged the 10-day record held by a Honolulu disc jockey.

He put in 264 hours, bracing himself with innumerable hot and cold showers. Toward the end of his ordeal his concentration deteriorated, his memory became erratic, his conversation halting, his equilibrium poor. As the eleventh day began, researchers at San Diego Naval Hospital attached 19 wires to record his bodily reactions to sleep—14 hours and 43 minutes of it. "I feel like I've been asleep for 70 days," he said on awaking.

How much wakefulness a man can ultimately take is unknown, as are the human limits to just about any kind of endurance. "Every time science thinks it has discovered the absolute maximum," says Air Force survival-expert Dr. Paul H. Nesbit of the Air University at Maxwell Field, Ala., "somebody comes up and breaks it." For instance:

- Michael Morley, 12, of Cleveland. When his toy parachute got entangled on a high-tension line two years ago, Michael climbed up to get it. He touched the power lines, and 22,000 volts ripped through his body and flung him down from the five-story tower. He lost one arm, but he lived.

- Second Steward Poon Lim of the British Merchant Navy. In 1942, when his ship went down in the Atlantic, he took to the sea in a lifeboat. He was picked up by fishermen 4½ months later, and amazingly he was able to walk ashore unaided.

- Michael D. Leonard, a para-rescueman of the 48th Air Rescue Squadron at Eglin AF Base, Fla. Recently he jumped from a helicopter, plummeted 1,000 feet as his main and reserve parachutes failed to open. When he hit the ground, he did a flip, got up, and walked away with only a scratched knee. ■■

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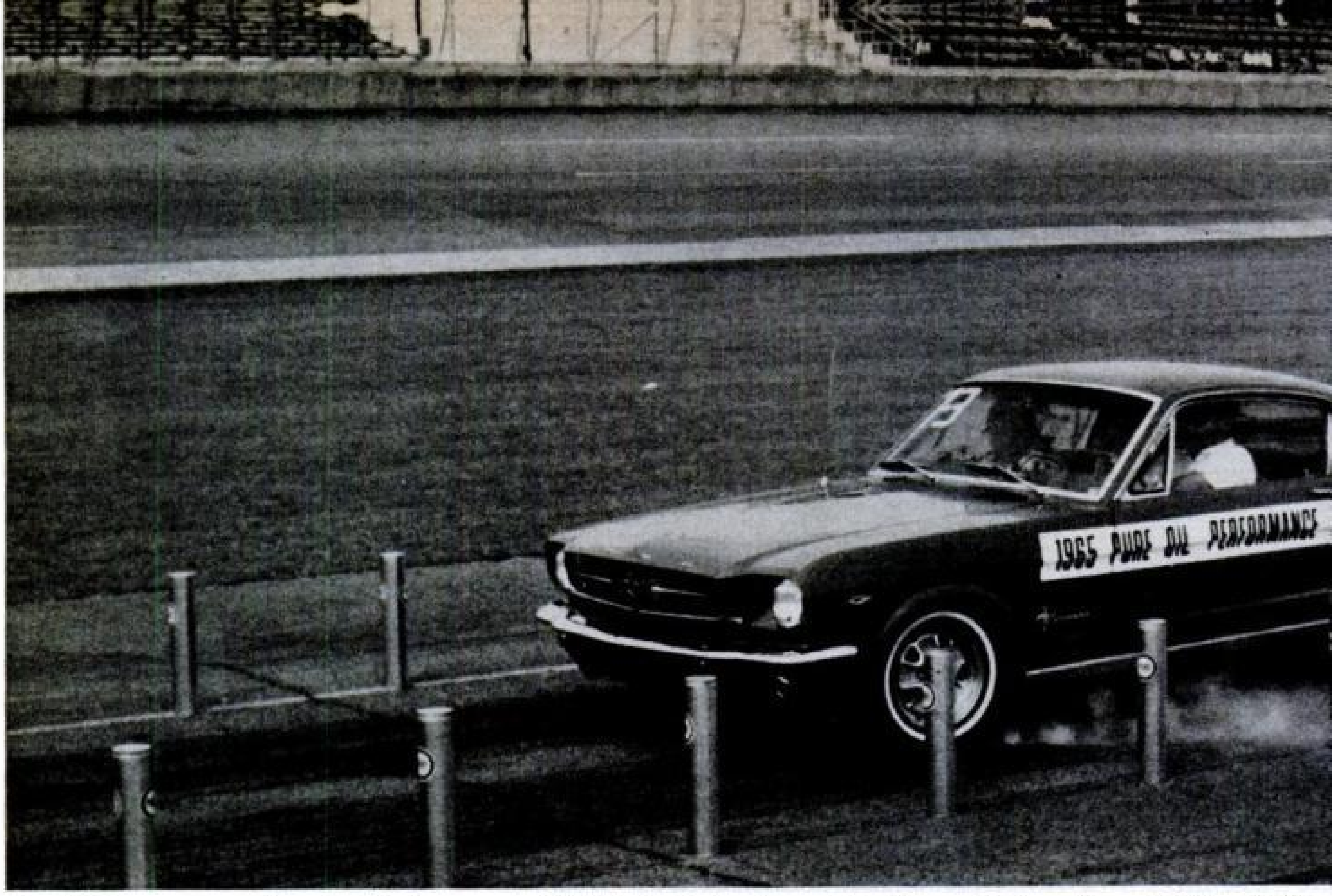


Ford Mustang smokes in Performance Trials test, in dramatic show of stopping ability. Fifth

How Fast Can You

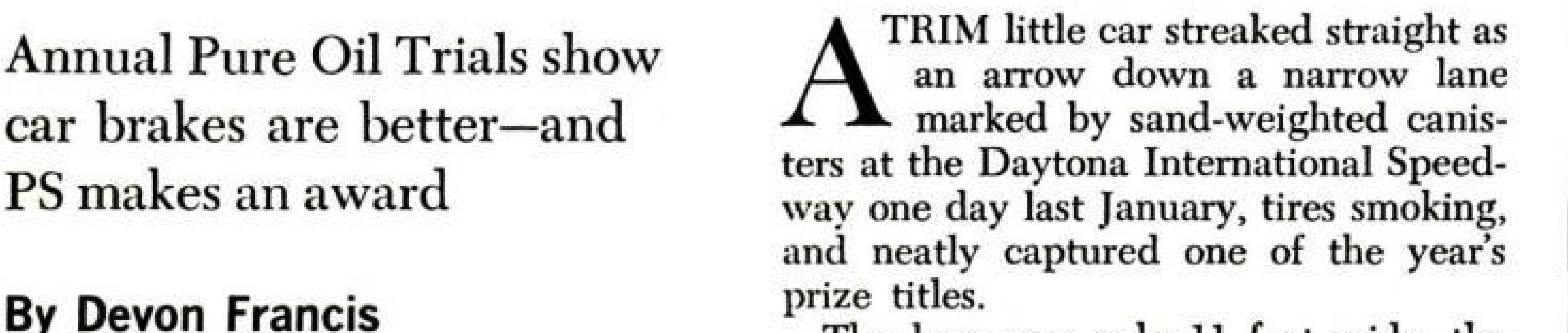
Annual Pure Oil Trials show car brakes are better—and PS makes an award

By Devon Francis

A TRIM little car streaked straight as an arrow down a narrow lane marked by sand-weighted canisters at the Daytona International Speedway one day last January, tires smoking, and neatly captured one of the year's prize titles.

The lane was only 11 feet wide, the

Here's how Tempest LeMans won Popular Science Gold Cup



Actual picture sequence of Pontiac Tempest LeMans in brake test shows car pulling down to stop in 161.8 feet from 65 m.p.h. after eight hard, deliberate "panic" stops from 70 m.p.h. Tempest's brakes exhibited no fade. Car was driven by Dave Senk of GM Proving Ground.

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wheel is one of three checks used for distance.

STOP?

easily upset canisters spaced three feet apart. The occasion was the 1965 Pure Oil Performance Trials, an annual series of tests that has been fully covered by POPULAR SCIENCE since 1963.

This event was part three of the trials —the comparative braking of 32 different brands and models of U.S.-made cars.

CONTINUED

Tires burned on all cars when brakes were effective because drivers locked them up rather than hazard a try for maximum friction coefficient.

PS Gold Cup is inscribed: "POPULAR SCIENCE GOLD CUP AWARD FOR BRAKE PERFORMANCE. AWARDED FOR THE SHORTEST OFFICIAL STOPPING DISTANCE AT THE 1965 PURE OIL PERFORMANCE TRIALS." Plaque on the base cites Pontiac.

Gold Cup Award highlights importance of brake tests

POPULAR SCIENCE has presented its first annual Gold Cup Award to the Pontiac Motor Division of the General Motors Corporation for having achieved the shortest stopping distance in the 1965 Pure Oil Performance Trials.

A Pontiac Tempest LeMans was victorious at 161.8 feet—35 feet less than the *average* of all 57 cars that ran the course at Daytona's International Speedway.

POPULAR SCIENCE's Editor-in-Chief, Ernest V. Heyn, stated, "We are presenting the Gold Cup to the winner of this event to highlight the importance of the test to the public, and to give deserved recognition to the manufacturer who is currently leading in the competition for better brakes."

Hubert P. Luckett, Executive Editor, said, "Brake performance is the most difficult part of a car for the average buyer to evaluate.

"Any modern car has adequate brakes for normal use. But drivers of high-powered cars are apt to get into situations occasionally that make abnormal demands on the brakes. Superior brake performance at this time can mean the difference between life and death. And it takes professional skill and facilities to test for this kind of brake reliability."

Urheberrechtlich geschütztes Material

How They Scored

Class	Car	Engine Type	Displacement (cu. in.)	Carburetors	Horsepower	Transmission	Wheelbase	Overall Length (in.)	Economy: Miles per Gallon	Economy: Points	Acceleration: Time (sec.)	Acceleration: Points	Braking: Stopping Distance (ft.)	Braking: Points	Total Points
CLASS I LUXURY	Buick Electra 225	V-8	401	4-bbl.	325	auto.	126	224.1	S.V.	0	7.985	5	211.5	6	11
	Buick Electra 225	V-8	401	4-bbl.	325	auto.	126	224.1	16.352	8	7.970	6	208.4	7	21
	Olds 98 Holiday	V-8	425	4-bbl.	360	auto.	126	222.9	15.365	6	7.425	9	199.8	9	24
	Olds 98 Holiday	V-8	425	4-bbl.	360	auto.	126	222.9	16.253	7	7.370	10	172.6	10	27
	Pontiac Bonneville Brougham	V-8	421	4-bbl.	359	auto.	124	221.7	16.968	9	7.480	8	200.3	8	25
	Pontiac Bonneville Brougham	V-8	421	4-bbl.	359	auto.	124	221.7	17.969	10	7.650	7	DNF	0	17
CLASS II DELUXE–8-CYLINDER	Buick Wildcat	V-8	401	4-bbl.	325	auto.	126	219.8	16.893	7	7.415	6	179.0	5	18
	Buick Wildcat	V-8	401	4-bbl.	325	auto	126	219.8	17.037	8	8.135	5	164.8	10	23
	Chrysler Newport	V-8	383	2-bbl.	270	auto.	124	218.2	14.500	3	12.030	3	252.8	3	9
	Mercury Monterey	V-8	390	2-bbl.	250	auto.	123	218.4	15.395	4	11.990	4	175.5	8	16
	Olds Jetstar I	V-8	425	4-bbl.	370	auto	123	216.9	15.449	5	6.635	9	173.6	9	23
	Olds Jetstar I	V-8	425	4-bbl.	370	auto.	123	216.9	15.482	6	6.580	10	224.9	4	20
	Pontiac Bonneville	V-8	389	4-bbl.	335	auto.	124	221.7	18.551	10	7.300	7	176.3	7	24
	Pontiac Bonneville	V-8	389	4-bbl.	335	auto.	124	221.7	17.949	9	7.085	8	176.4	6	23
CLASS III MEDIUM–8-CYLINDER	Buick LeSabre 400	V-8	300	4-bbl.	250	auto.	123	216.8	19.512	9	9.485	8	256.5	4	21
	Buick LeSabre 400	V-8	300	4-bbl.	250	auto.	123	216.8	19.629	10	9.680	4	320.1	3	17
	Chevrolet Impala	V-8	327	4-bbl.	250	auto.	119	213.1	19.036	8	9.670	5	170.1	10	23
	Chevrolet Impala	V-8	327	4-bbl.	250	auto.	119	213.1	18.794	7	9.725	3	179.4	6	16
	Dodge Polara	V-8	383	2-bbl.	270	auto.	121	212.3	15.582	3	12.455	2	483.3	2	7
	Olds Jetstar 88	V-8	330	2-bbl.	260	auto.	123	216.9	18.021	5	9.510	6	176.2	9	20
	Olds Jetstar 88	V-8	330	2-bbl.	260	auto.	123	216.9	18.341	6	9.495	7	177.2	8	21
	Pontiac Grand Prix	V-8	389	4-bbl.	333	auto.	121	214.6	16.504	4	7.880	9	179.0	7	20
	Pontiac Grand Prix	V-8	389	4-bbl.	333	auto.	121	214.6	14.700	2	7.600	10	179.6	5	17
CLASS IV SMALL–8-CYLINDER	Buick Special Deluxe	V-8	300	2-bbl.	210	auto.	115	203.4	21.382	10	10.000	5	179.9	6	21
	Buick Special Deluxe	V-8	300	2-bbl.	210	auto.	115	203.4	20.689	9	9.315	6	172.0	9	28*
	Chevelle Malibu	V-8	283	2-bbl.	195	auto.	115	196.6	19.955	7	11.085	2	186.5	4	13
	Chevelle Malibu	V-8	283	2-bbl.	195	auto.	115	196.6	19.439	4	11.785	1	188.1	2	7
	Ford Fairlane	V-8	289	2-bbl.	200	auto.	116	198.8	19.621	6	10.325	4	182.2	5	15
	Ford Fairlane	V-8	289	2-bbl.	200	auto.	116	198.8	19.613	5	10.505	3	186.8	3	11
	Olds Cutlass	V-8	330	4-bbl.	315	auto.	115	204.4	18.900	2	7.585	9	179.5	7	18
	Olds Cutlass	V-8	330	4-bbl.	315	auto.	115	204.4	18.629	1	7.420	10	204.0	0	11
	Plymouth Belvedere I	V-8	273	2-bbl.	180	auto.	116	203.4	18.206	0	13.650	0	198.9	1	1
	Pontiac Tempest LeMans	V-8	326	2-bbl.	250	auto.	115	206.1	19.960	8	8.655	8	178.4	8	24
	Pontiac Tempest LeMans	V-8	326	2-bbl.	250	auto.	115	206.1	19.284	3	8.875	7	161.8	10	20
CLASS V STANDARD–6-CYLINDER	Buick Special	V-6	225	1-bbl.	155	auto.	115	203.4	22.896	7	14.270	7	175.8	4	18
	Buick Special	V-6	225	1-bbl.	155	auto.	115	203.4	21.249	0	13.780	10	169.9	9	19
	Chevelle 300	OHV-6	194	1-bbl.	120	auto.	115	196.6	21.511	1	20.260	0	179.6	1	2
	Chevelle 300	OHV-6	194	1-bbl.	120	auto.	115	196.6	22.304	6	19.330	1	172.0	7	14
	Ford Custom	OHV-6	240	1-bbl.	150	auto.	119	210.0	21.164	0	15.000	6	177.8	2	8
	Ford Fairlane	OHV-6	200	1-bbl.	120	auto.	116	199.0	23.277	9	17.650	2	175.5	5	16
	Olds F-85	V-6	225	1-bbl.	155	auto.	115	204.4	21.723	3	13.915	9	170.2	8	23**
	Olds F-85	V-6	225	1-bbl.	155	auto.	115	204.4	21.802	5	14.230	8	176.7	3	16
	Pontiac Tempest	OHV-6	215	1-bbl.	140	auto.	115	206.1	22.954	8	DNF	0	DNS	0	8
	Pontiac Tempest	OHV-6	215	1-bbl.	140	auto.	115	206.1	23.373	10	16.075	4	174.2	6	23
	Rambler Ambassador 880	OHV-6	232	2-bbl.	155	auto.	116	200.0	21.577	2	16.065	5	222.2	0	7
	Rambler Ambassador 880	OHV-6	232	2-bbl.	155	auto.	116	200.0	21.771	4	17.155	3	169.6	10	17
CLASS VI COMPACT–6-CYLINDER	Chevrolet Corvair 500	H-6	164	2 1-bbl.	95	auto.	108	183.3	24.894	5	19.190	5	177.3	6	16
	Chevrolet Corvair 500	H-6	164	2 1-bbl.	95	auto.	108	183.3	24.990	6	18.670	8	165.0	10	24
	Dodge Dart	OHV-6	170	1-bbl.	101	auto.	111	196.4	21.139	4	20.580	4	304.6	4	12
	Ford Falcon	OHV-6	170	1-bbl.	105	auto.	109.5	181.6	26.043	7	17.800	9	174.3	7	23
	Ford Falcon	OHV-6	170	1-bbl.	105	auto.	109.5	181.6	26.629	8	17.375	10	169.7	8	26
	Rambler American 440	OHV-6	195.6	1-bbl.	125	auto.	106	177.3	27.542	10	18.925	6	168.8	9	25
	Rambler American 440	OHV-6	195.6	1-bbl.	125	auto.	106	177.3	26.636	9	18.825	7	270.5	5	21
CLASS VII SPORTS COMPACT	Chevy II Nova S.S.	V-8	283	2-bbl.	195	4-spd.	110	182.9	23.092	8	9.695	8	175.2	8	24
	Chevy II Nova S.S.	V-8	283	2-bbl.	195	4-spd.	110	182.9	22.230	7	10.195	6	174.5	9	22
	Ford Mustang 2 + 2	V-8	289	2-bbl.	200	3-spd.	108	181.6	24.082	9	9.775	7	173.9	10	26***
	Ford Mustang 2 + 2	V-8	289	2-bbl.	200	3-spd.	108	181.6	24.249	10	9.615	9	176.3	7	26***
	Comet Cyclone	V-8	289	4-bbl.	225	4-spd.	114	195.3	18.319	5	8.515	10	191.0	6	21
	Plymouth Barracuda	V-8	273	2-bbl.	180	auto.	106	188.2	19.454	6	11.995	5	244.7	5	16

SV, score voided; DNS, did not start; DNF, did not finish; *winner by 4 bonus points; **winner in runoff; ***tie.

Class winners: I—Olds 98 Holiday. II—Pontiac Bonneville. III—Chevrolet Impala. IV—Buick Special Deluxe. V—Olds F-85. VI—Ford Falcon. VII—Ford Mustangs, tie. Acceleration time: 25-70 m.p.h.

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The title captured in the narrow lane: the quickest-braking car of all the 59 cars entered. The victorious automobile was a Pontiac Tempest LeMans.

It was not an all-time record for the trials. Cars have been braked to a stop in slightly shorter distances in some previous years.

But this year's shortest stopping distance was significant when considered in the context of the contest. Here's why:

In 1964's Pure Oil Trials, the average stopping distance for 56 cars was 210.4 feet. *A total of 24 cars exceeded this average.*

In 1965, the average stopping distance for 57 cars was cut to 196.2 feet. *Only 15 cars exceeded this average.* One car did not start the braking test. One did not finish.

Plainly, brakes on U.S. cars are getting better.

The quick-stoppers. Here are the cars that did better than average: Buick Special Deluxe, Buick Special, Buick Wildcat, Chevelle Malibu, Chevelle 300, Chevrolet Impala, Chevrolet Corvair, Chevrolet II Nova S.S., Mercury Comet Cyclone, Ford Falcon, Ford Mustang, Ford Custom, Ford Fairlane, Mercury Monterey, Olds 98 Holiday, Olds Jetstar I, Olds Jetstar 88, Olds Cutlass, Olds F-85, Pontiac Bonneville, Pontiac Grand Prix, Pontiac Tempest, Tempest LeMans, Rambler Ambassador, and Rambler American.

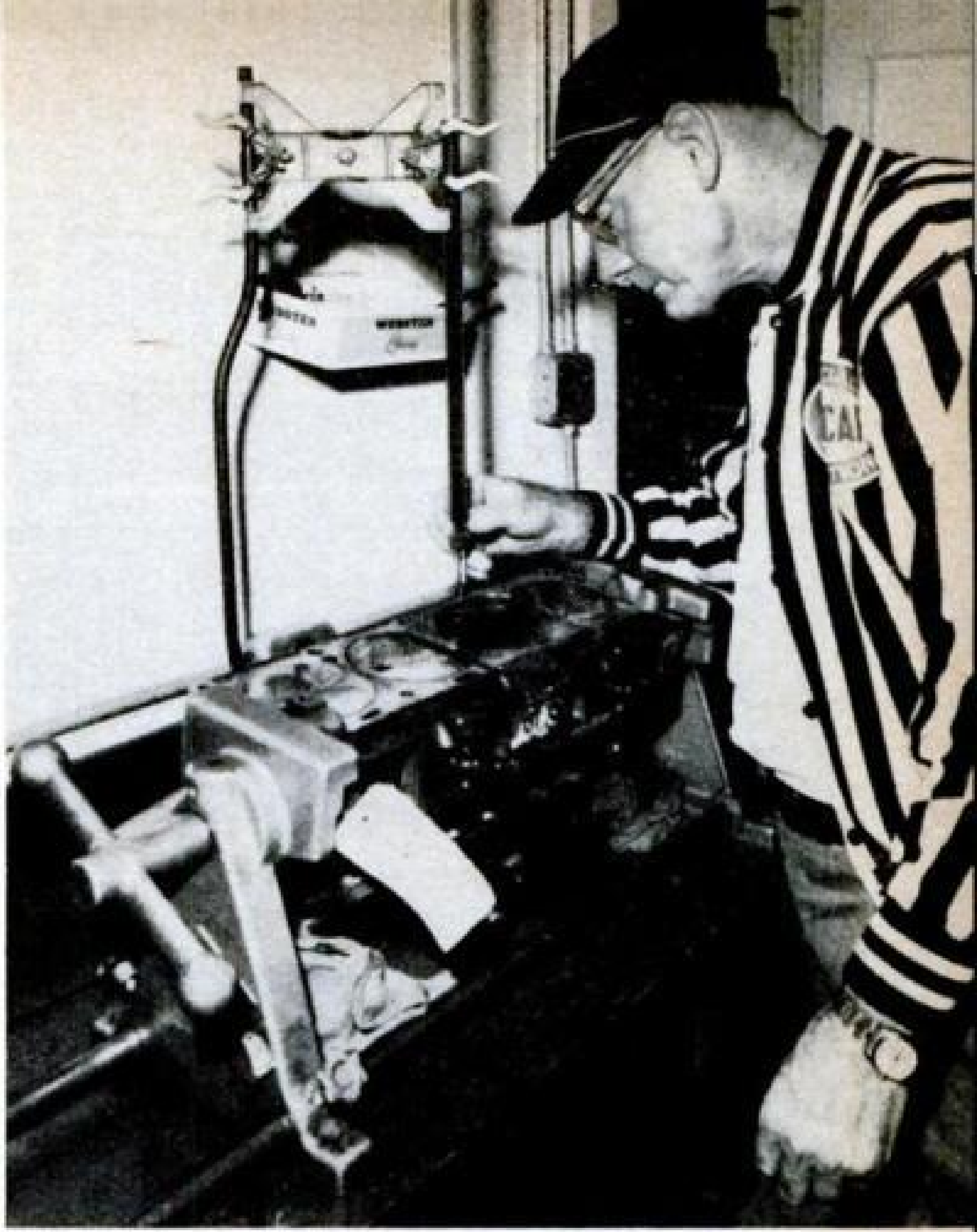
These cars do not tote up to 42 (57 minus 15) because of duplicate entries.

The cars making the most decided braking gains for '65 over '64 were: the Chevy Impala, Ford Custom, Olds 88, Mercury Monterey, Pontiac Tempest, and Rambler American.

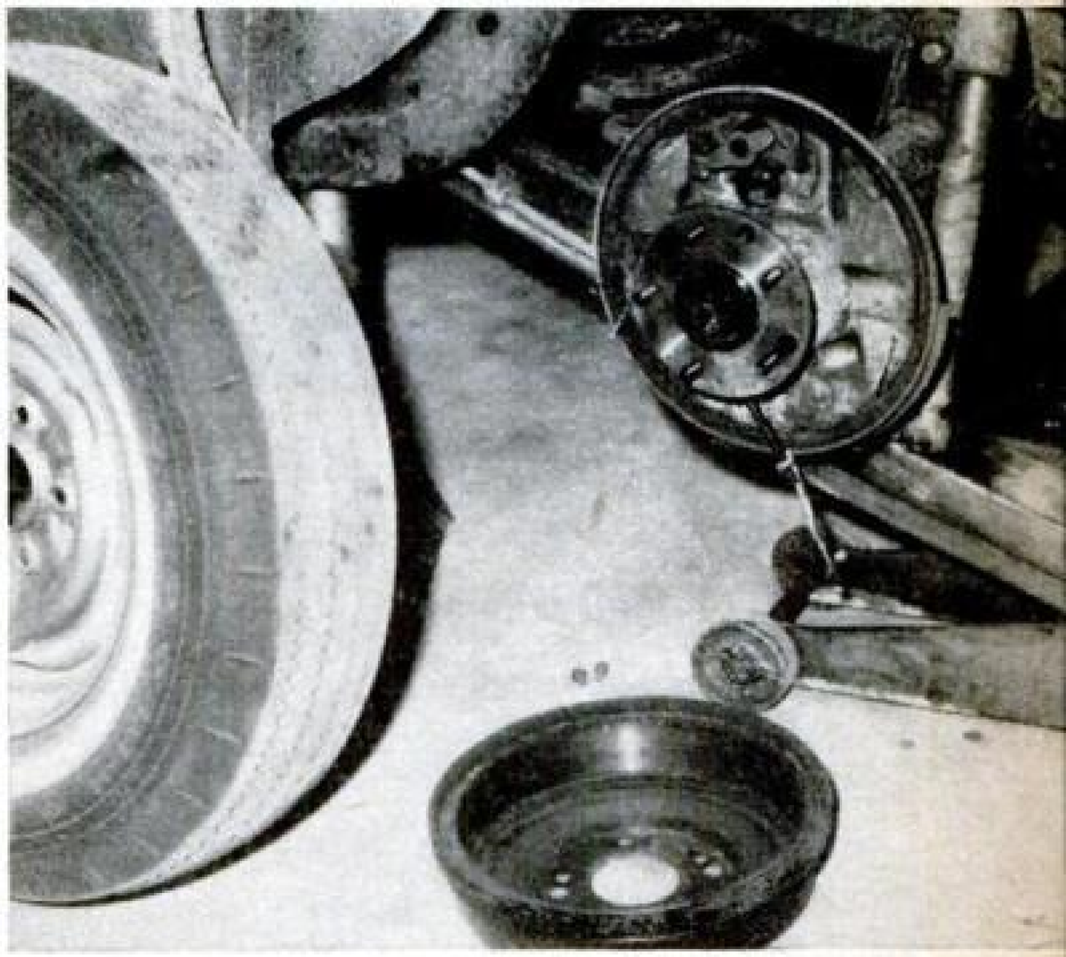
Last year, the most miserable individual performers in the braking contest were Ford and Olds. Chrysler Corp. products—Dodge, Plymouth, Dart, and Valiant—shared bad braking records with those two cars plus Chevrolet, Buick, Mercury, and the Pontiac Tempest.

This year, cars with the poorest showing in the braking trials included the Chrysler products plus one each of the two cars entered for the Olds Jetstar I, Rambler Ambassador, Rambler American, and both of two Buick LeSabres. One car suffered complete brake fade.

Not all brands of cars were represented



NASCAR specialists check engine blocks and heads for exact size to determine if cubages are correct. Sometimes mechanics try to cheat by milling engine areas normally left rough.



Brakes are examined meticulously, micrometered for exact size. Pistons are even removed from brakes' hydraulic cylinders for examination. Improper burnishing draws drastic penalties.

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Urheberrechtlich geschütztes Material

Green flag waves off a Chevrolet Chevelle "300" on economy run. Run must be made at an average of 40 m.p.h. or more. On one segment, car must do 65 m.p.h. for 11.8 seconds.

Bags of sand are put aboard to cancel any weight advantage due to poundage of driver or observer. New for '65 instrumentation was an electronic timer triggered by the fifth wheel.

in the test, nor, indeed, were all companies or divisions officially entered. There was no Cadillac, Lincoln, Chrysler Imperial, Chrysler New Yorker, or Ford Thunderbird. The Chrysler Corp. did not sponsor any of the entries that it manufactures, nor did Ford's Lincoln-Mercury division sponsor the single Mercury Monterey and Mercury Comet Cyclone entered.

Private individuals entered these cars. They ran under handicaps—none had a back-up, or twin, to support it. None had a factory team to prepare it.

The tests are broken down into three classes—fuel economy, acceleration, and braking.

They are the most completely instrumented, scientific, and meaningful tests ever conducted by an agency independent of the car manufacturers themselves.

"Consumer's concept" classes. Whereas last year there were six classes based on engine size and wheelbase—with a winner in each class—this year there were seven classes representing a "consumer's concept," based on car size, engine size, price, and wheelbase. Again, each class had a winner.

The highest point total in each of the classes in the accompanying chart indicates the top car.

Most brands and models, taking advantage of the rules, were entered in sets of two. Each stood on its own record.

This year's rules on fuel economy and acceleration were essentially those of last year, but some major changes were made in braking—the most important ingredient of the test affecting safe driving. Every shoe on every car was replaced by officials of the National Association for Stock Car Auto Racing, the organization that runs the trials for Pure Oil, and each of these shoes was bought "off the shelf" by NASCAR from a regular supplier for that brand of car.

Another major change covered "burnishing"—seating—the brakes. Each shoe was daubed with a white paint that had

[Continued on page 216]

Urheberrechtlich geschütztes Material

Here is the suit that will protect those who walk upon the first celestial body to be explored by earthmen

What an Astronaut Will Wear on the Moon

By Dr. Wernher von Braun

Director of NASA's George C. Marshall Space Flight Center, Huntsville, Ala.

SPACE suits in which Apollo astronauts will walk the surface of the moon have come a long way from the pressurized diving rig of rubberized canvas, topped by a cylindrical metal helmet, in which Wiley Post in 1934 attempted to break the world's altitude record.

The list of the Apollo suit's requirements is so long, and they are so conflicting, that for a long time some of the people closest to the problem ex-

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Urheberrechtlich geschütztes Material

Moon suit's needs make "shopping list for Santa Claus"

Formidable number of requirements, many of them conflicting, has had to be met by designers of Apollo garb. Dr. von Braun (center) and others at Marshall center inspect a Navy flight suit, the design of which is similar to that of Apollo space suit pictured on the preceding page.

pressed serious doubts whether the job could be done at all.

What a moon suit must do. Just for a sample of the needs, this suit must:

- Protect the wearer from the vacuum of space when the command module, or crew cabin, is depressurized—and when he is outside of it.
- Keep the temperature around him comfortable, in all the following situations: inside the air-conditioned command module; outside the command module, both in bright sunlight and in the earth's shadow, during unpowered flight through space; and on the lunar surface, during day and night.
- Provide a compatible backpack whose oxygen supply will last several hours—and can be renewed, by plugging in to the ship's oxygen supply, for periods up to several weeks.
- Enable the wearer to eat and drink, under zero-gravity conditions, without breaking the suit's sealed atmosphere.
- Permit him to communicate by voice when the command module is pressurized and the three astronauts have their faceplates open; and by radio, outside the ship and on the moon's surface.
- Give him a reasonable degree of protection from micrometeorites when he is walking on the lunar surface.
- Permit storage and collection of body wastes, and have provisions for eliminating them.
- Enable the wearer to walk comfortably over rugged terrain on the moon (where the gravity is only one-sixth of what it is on earth), with the suit pressurized and backpack in place.
- Allow him to get back on his feet unaided, if he should stumble and land on his back like a June bug.
- Permit him to do work requiring some manual dexterity, with his suit and gloves pressurized.
- Be light and flexible—yet sturdy enough to avert critically dangerous punctures by contact with jagged rock formations on the moon.
- Enable the Apollo astronaut to shed or don it quickly in the cramped space of his command module, under zero-gravity conditions and without help.

These dozen items' desirability will be as obvious as the difficulty of providing them. They have been likened to "a shopping list for Santa Claus."

The Apollo moon suit is the answer to this imposing array of specifications. It is being developed by the Hamilton Standard Division of United Aircraft, at Windsor Locks, Conn., under a contract with NASA's Manned Spacecraft Center, Houston, Tex.

How Apollo suit fills the bill. The forthcoming moon suit is best described by progressing, stepwise, from the astronaut's skin outward.

To remove body heat effectively, the innermost garment is a set of water-cooled long johns, worn directly on the bare skin.

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Urheberrechtlich geschütztes Material

Will a twist of the wrist steer your next car?

Some years ago the Ford Motor Co. offered a job to an engineer named Robert J. Rumpf.

"But I don't know anything about automobiles," he protested. He specialized in missile design.

"Good," said Ford. "Then maybe you'll come up with some new ideas."

He has. With a dedicated little band of conspirators, Rumpf has designed the first new steering control to appear on a car in more than a half-century. It's called "wrist-twist instant steering," and it's about the most delightful novelty in car equipment since the advent of the automatic transmission. For now, it's only experimental.

The wrist-twist design substitutes for the standard steering wheel two plastic rings five inches in diameter, mounted on the ends of brackets that are somewhat like a steering wheel's spokes. The steering column, of conventional design, tilts.

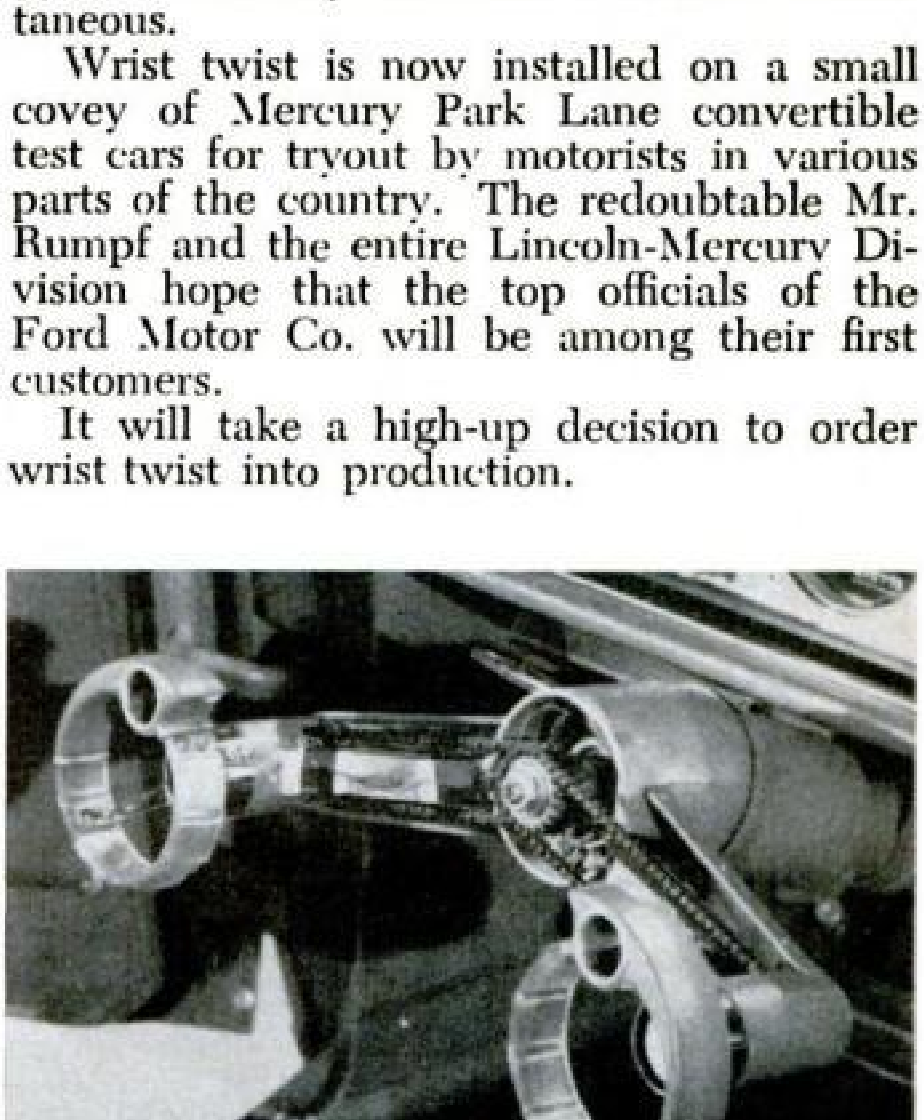
To steer, you rotate the rings. They are power-boosted. Chains and sprockets interconnect them. The car's front wheels respond to either or both rings.

This may sound as nutty as the steering wheel did to the motorist who learned to drive by tiller, but it works like a charm. The steering effort is a fraction of that with a regular wheel. That's because only the forearm, wrist, and hand are involved, as against the full arm, torso, and even the neck in standard steering. Coupled with a fast, 15:1 gear ratio, this makes the response of the front wheels much quicker and more precise.

Adaptation to the new kind of steering by the ordinary motorist is almost instantaneous.

Wrist twist is now installed on a small covey of Mercury Park Lane convertible test cars for tryout by motorists in various parts of the country. The redoubtable Mr. Rumpf and the entire Lincoln-Mercury Division hope that the top officials of the Ford Motor Co. will be among their first customers.

It will take a high-up decision to order wrist twist into production.



Wrist twist's simple mechanism is shown above with cover off. Absence of wheel aids vision.

Urheberrechtlich geschütztes Material

The new compacts come in a wide variety of sizes and shapes. Shown here are examples of one-suitcase, two-suitcase, walnut-cabineted, and swing-down models. Performance, surprisingly, was not closely related to size, weight, shape, or price.

How Good Are Those SUITCASE STEREO SYSTEMS?

By Ken Gilmore and Hubert Luckett

PORTABLE phonographs aren't new. They've been around since "The Sheik of Araby" was number one on the top 20 and you turned a crank on the talking machine to make it go. But despite their long tradition, most portables through the years have been what one hi-fi expert called "ear-grating compendia of technical shortcomings." With high distortion, poor bass, and treble like a rusty hinge, the sound from these torture machines had all the charm of a duet between a concrete mixer and a love-starved cat.

Now, things have changed. The technological fallout of the hi-fi age has finally trickled down to the listener who wants his music on the move. A new generation of portable stereo equipment, most of it built by the firms who have made their names in the high-fidelity field, is now on the market.

To find out how good these new portable music makers are, POPULAR SCIENCE rounded up a representative batch and put them through a series of listening tests. For the sake of comparison, we also got together several of the wood-cased stereo compacts on the market. These units—first cousins of the traveling models—are meant for permanent installation, but are smaller and less expensive than regular-component hi-fi.

The models tested varied widely in size (from one slim suitcase to two bulky ones), in weight (from 28 to 55 pounds for portables), and in price ($89.95 to $389). They varied in quality from mediocre to excellent.

Generally, the POPULAR SCIENCE panel reached three principal conclusions:

1. The quality—and quantity—of sound produced by the best of the compacts is impressive. They don't, of course, deliver the spectacular bass characteristic of more expensive speakers. If you long to have the

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Urheberrechtlich geschütztes Material

With two units playing simultaneously, volume was turned up alternately for comparison. Early tests were done with testers' backs to equipment to keep identity secret

BUYER'S GUIDE TO SUITCASE STEREO

NAME	PRICE	WEIGHT (lb.)	STYLE	TURNTABLE	CARTRIDGE	AUXILIARY INPUTS	HEADPHONE JACKS
GROUP 1A							
KLH Model 11 (Singer)	$199.95	28	1 Suitcase	Garrard with low-mass tone arm	Pickering magnetic	1	No
Shure M-100L	$389.00	55	2 Suitcases	Dual 1009	Shure M-15	2	No
Sylvania	$198.80	39	Swing-down	Garrard with low-mass tone arm	Ceramic	1	Yes
GROUP 1B							
Benjamin Stereo 200, 208 Speaker Systems	$328.50	80	Walnut cabinet with separate speakers	Miracord 10	Elac 222	1	No
Fisher 75	$269.50	40		Garrard AT 60	Pickering magnetic	1	Yes
Scott Stereo Compact	$299.95	50		Garrard 50	Pickering magnetic	2	Yes
GROUP 2							
Columbia Masterwork M 1916	$199.95	35	2 Suitcases	Garrard 50	Pickering magnetic	1	No
Electro-Voice Entertainer I	$235.00	36	2 Suitcases	Garrard with low-mass tone arm	Ceramic	No	No
Fisher 50	$229.50	35	1 Suitcase	Garrard AT 60	Pickering magnetic	2	Yes
Pilot XKE-3000 Solid State Portable	$199.50	32	1 Suitcase	Garrard AT 50	Pickering magnetic	1	No
GROUP 3							
Motorola PP 90A	$149.95	41	Swing-down	Special	Ceramic	No	No
Philco 1506	$189.95	37	Swing-down	Garrard with low-mass tone arm	Ceramic	No	No
GROUP 4							
Admiral Y 8180	$110.00	49	Swing-down	Special	Ceramic	No	No
GROUP 5							
Lafayette Solid State Portable	$ 89.95	34	Swing-down	Garrard 1000	Ceramic	No	No

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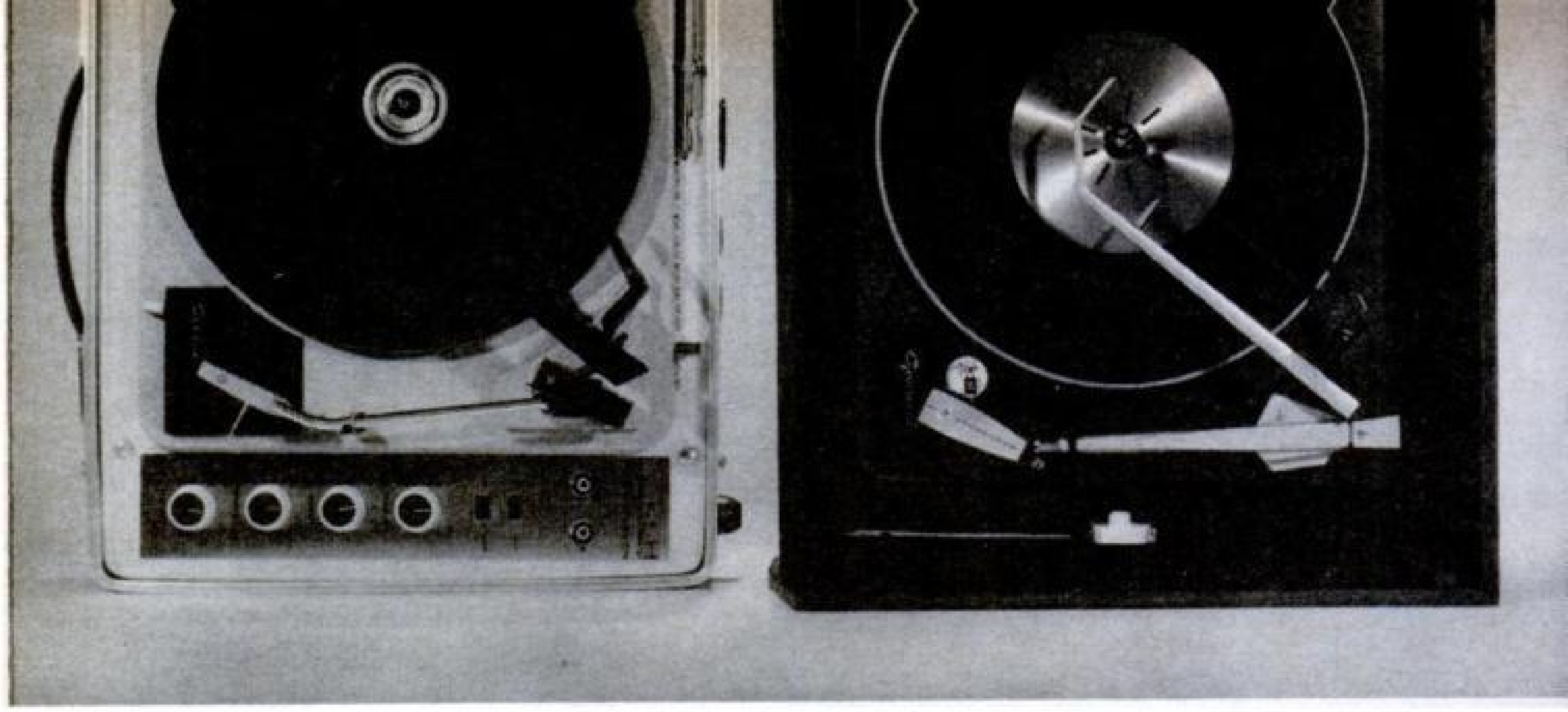


Most phonographs tested used Garrard-turntables, but many different versions were seen. The KLH (left) uses an AT50 changer, but with a specially designed low-mass arm. At right is a similar changer with standard arm, used on the Scott Stereo Compact. The Shure and Benjamin units (not shown) used the costlier Dual 1009 and Miracord 10, respectively.

lowest pedal tones of the organ rattle your bridgework, forget the portables. But if you want listenable, well-balanced, wide-range sound, consider a compact—portable or stay-put.

2. The compacts probably offer the best sound-per-dollar bargain. Not long ago, any high-fidelity expert would say that nothing under $400 was worth listening to. These units prove that good sound can be had for half that price.

3. Sound quality, size, weight, and price are not necessarily related. Some of the best units were small and moderately priced.

Hi-fi in a cigar box. The trend toward compacts was begun more than two years ago by KLH Research and Development Co. of Cambridge, Mass. In the fall of 1962, KLH launched its famous Model 11—just 28 pounds of high-fidelity crammed into a slim suitcase. Industry experts dismissed it out of hand; obviously high-quality sound couldn't come from those two cigar-box-size speakers. The buying public, however, heard differently, and KLH had a runaway best seller overnight.

The competition cranked into high gear quickly, and by last fall had marketed almost a score of suitcase jobs and a sprinkling of walnut-cabineted nonportable compacts. Some are obviously cobbled together quickly, in an effort to get in on the boom—and they sound it. But many are of full-fledged hi-fi quality.

Two recent developments have put big performance into today's little players.

• *Transistors.* With these, and other miniature semiconductor components, engineers can build high-quality, reliable circuits in small packages—just the thing for suitcase stereo.

• *Advances in speaker design.* Up till now, the biggest obstacle to building a small, high-quality record player has been the poor performance of small speakers. The smaller the speaker, the harder it is to make it pump any worthwhile amount of bass power into the air. To combat this problem, KLH designed a sophisticated new kind of speaker whose bass response starts falling off at a higher frequency than regular speakers—but the fall-off is gradual, rather than abrupt, as in conventional designs of speakers.

Then it was fairly simple to design an amplifier to compensate for the so-called slow roll-off characteristic of the speaker. The result was an extremely small package with performance equalling that of a much larger rig.

Manufacturers of the many portable and compact units now on the market have applied the same principle in varying degrees. Some use considerably larger speakers than the KLH and less compensation, or none at all. These larger speakers, incidentally, can handle more low-frequency power; that is, they can make louder sounds on the low end without distortion.

But while there are wide variations, most of the units bear a general family resemblance. All of the 14 representative units we checked are built around record chang-

Urheberrechtlich geschütztes Material

Typical example of stereo compact meant for permanent installation is the Scott (left). KLH portable, right, was one of the smallest and lightest (28 pounds) of the suitcase jobs.

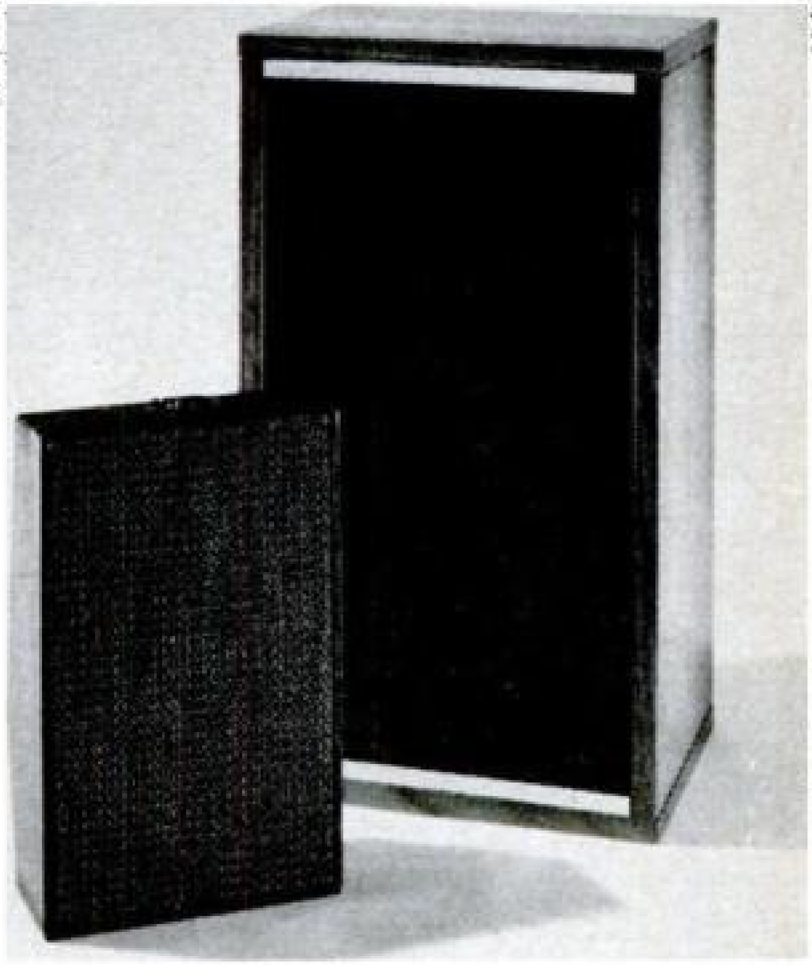
ers. Pickup cartridges show similar uniformity. Six use ceramic cartridges; eight, magnetic. The ceramics, incidentally, have flip styluses and, consequently, are suitable for playing 33-, 45-, and 78-r.p.m. records. The magnetics are equipped only for 33- and 45-r.p.m. records. For 78s, the cartridge would have to be changed. All models have detachable speakers that can be placed for good stereo separation.

The test setup. As in all POPULAR SCIENCE hi-fi evaluations, listening was done blind. Two identical records were started within seconds on two units, and the volume controls were turned up alternately. Since one record was leading the other by a few seconds, a judge could hear a musical passage played first on one machine, then immediately on the other. Machines were identified only by number until the listening was completed.

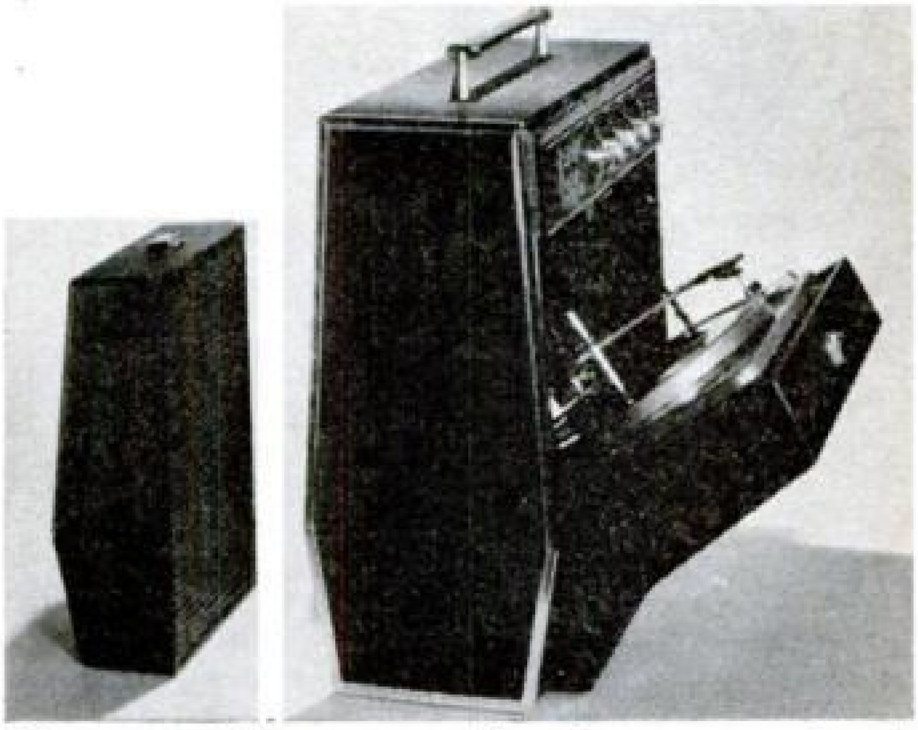
Final tabulation of the opinions of the judges showed striking agreement. Although one judge might like Unit A slightly better than Unit B, and another judge just the reverse, in no case was any unit given a high rating by one judge and a low rating by another.

The sound quality of the various phonographs differed considerably in basic character. Two units that sounded quite similar on one type of music—piano, for example—in some cases sounded quite different on another—such as a full orchestral passage with heavy bass. For this reason, many different kinds of music—piano, guitar, sing-

[*Continued on page 224*]



Speaker size of units varied widely, as illustrated by speaker enclosures of Sylvania (front) and Benjamin (rear). In general, the larger speakers had better bass-handling capacity.

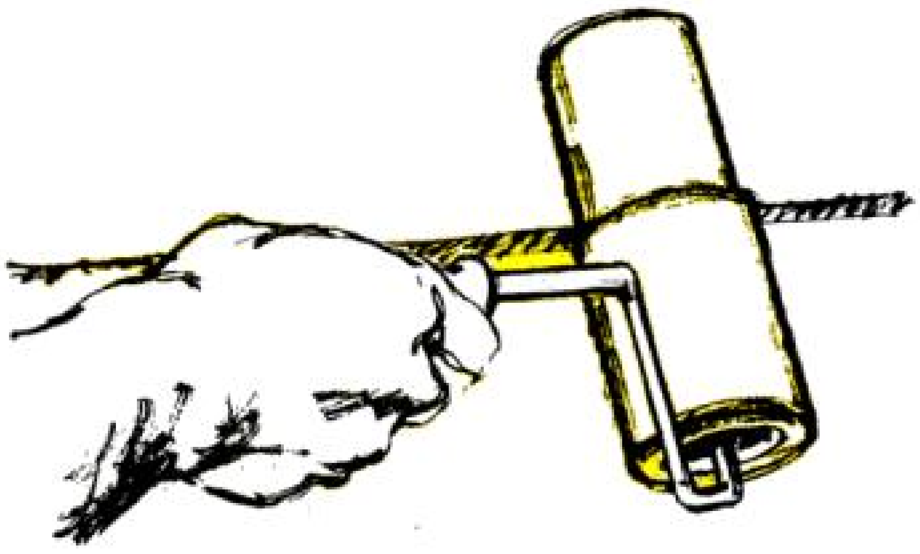


Most portables were packaged in conventional-looking suitcases (see KLH at top of page), but some, such as Sylvania, shown here, used the swing-down type of construction.

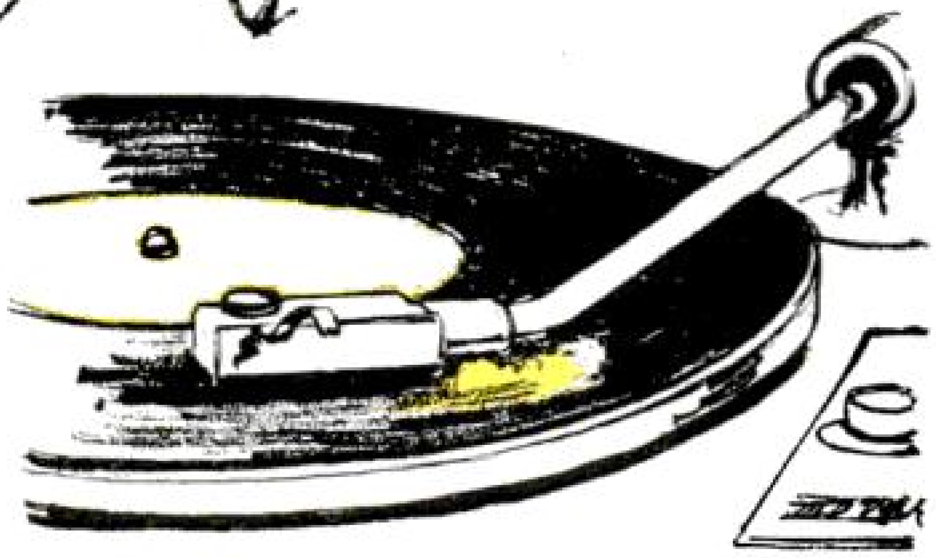
Urheberrechtlich geschütztes Material

“I’d like to see them make...”

Weatherproof baskets—hoops of fiberglass, nets of nylon—for outdoor basketball. On backboards of exterior plywood mounted on metal poles, they’d provide recreation for adults or for little leaguers in this sport. *Patrick McGrath, Ft. Thomas, Ky.*

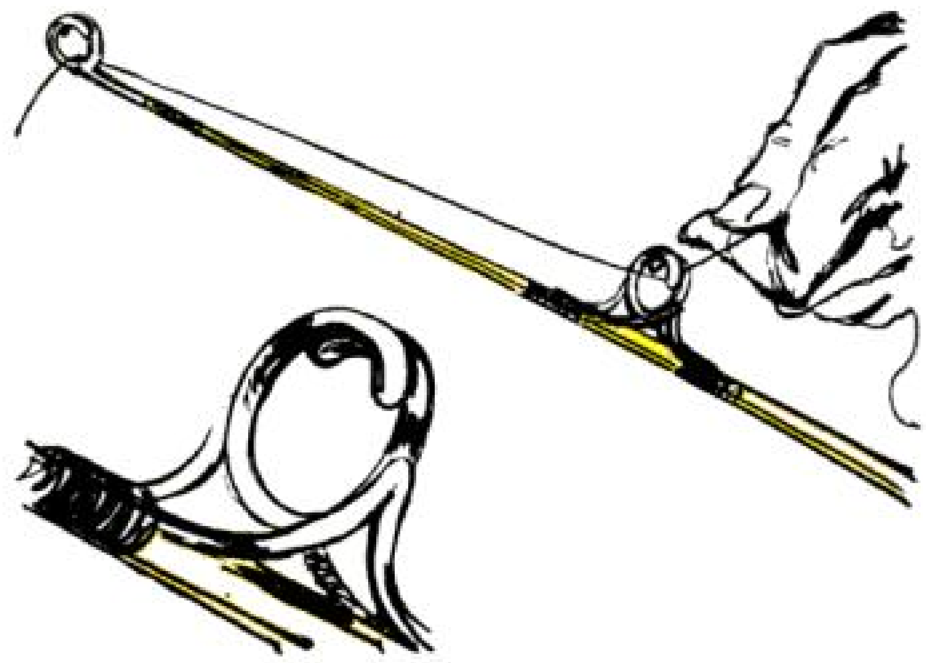


Split-level rollers for painting house siding. Stepped to fit under the overhang and partially coat two boards at once, they would speed up a job.—*M. G. Lummis, Kalamazoo, Mich.*



Air jets on phonographs with floating-cartridge pickup arms. A fan, run by the turntable motor, would aim air behind the stylus to dust off records.—*R. Deegan, Grand Rapids, Mich.*

Two-section sun visors for cars, so you could cover both windshield and side window at the same time, eliminating need for adjustment on winding roads.—*Brian Reed, Leduc, Can.*



Easy-to-string fishing rods with overlapping loops to take the line. Then you could put on or take off a line without removing the hook and sinkers.—*Mark Puhak, Masury, Ohio.*

Everyone has his own pet idea of a gadget that he would like to see in general use. What’s *yours?* We will pay $5 for each one published. Please use Government postcards only. Send to ILTS Editor, Popular Science, 355 Lexington Ave., NYC 10017. Write your name and address clearly. Contributions cannot be acknowledged or returned.

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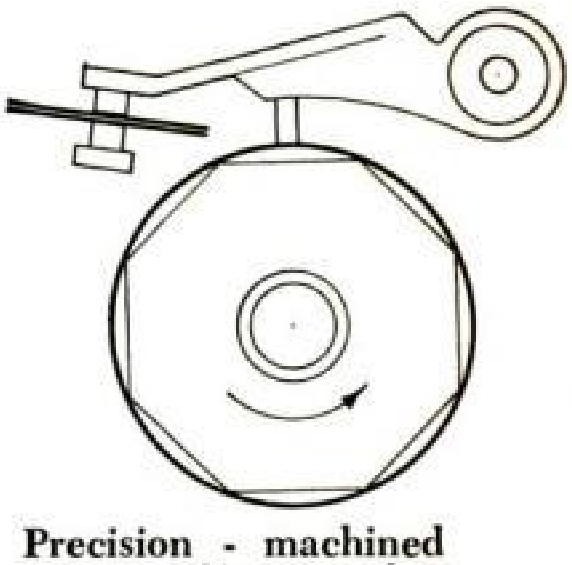
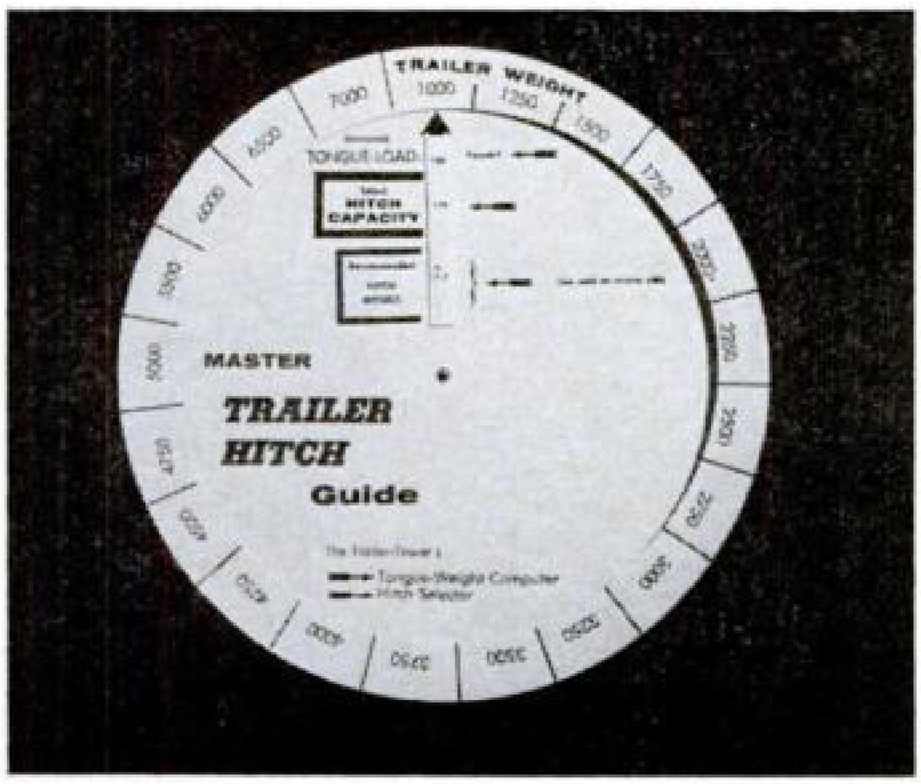


Precision - machined slip-on sleeve makes the distributor cam a perfect cylinder.

Slip-On Sleeves Make Point-Gapping Easy

THIS clever ignition-point-setting tool kit belongs in every car buff's toolbox. I found that it let me do the job in half the time of the usual feeler-gauge method. Its secret is a metal sleeve that slips over the distributor cam, turning the cam into a perfect cylinder. It eliminates rotating the distributor (or turning the engine over) until the point's rubbing block rests on a high point of the cam. The kit includes a set of sleeves that cover most distributors (except Delco closed models) and a special blade gauge that compensates for the increased cam diameter when the sleeve is in place. Price: $5.95. Kastar, Inc., Bellport, N.Y.—*R. Benrey.*



Guide selects the right trailer hitch

Set the arrow to the loaded weight of your trailer on this dial, and read off the estimated tongue load and suggested hitch capacity through the front window. A comprehensive table on the back lists suitable hitches of all capacities. $1.50, from Trailer Motive Testing, La Verne, Calif.

Automatic smog-valve tester

This simple device checks any PCV (positive crankcase vent) system in seconds: just place it over the oil-filler hole when the engine is idling. A movable ball will indicate either a slight crankcase vacuum (valve okay) or pressure (something is wrong). $3.98. Lenroc Co., S. San Francisco, Calif.

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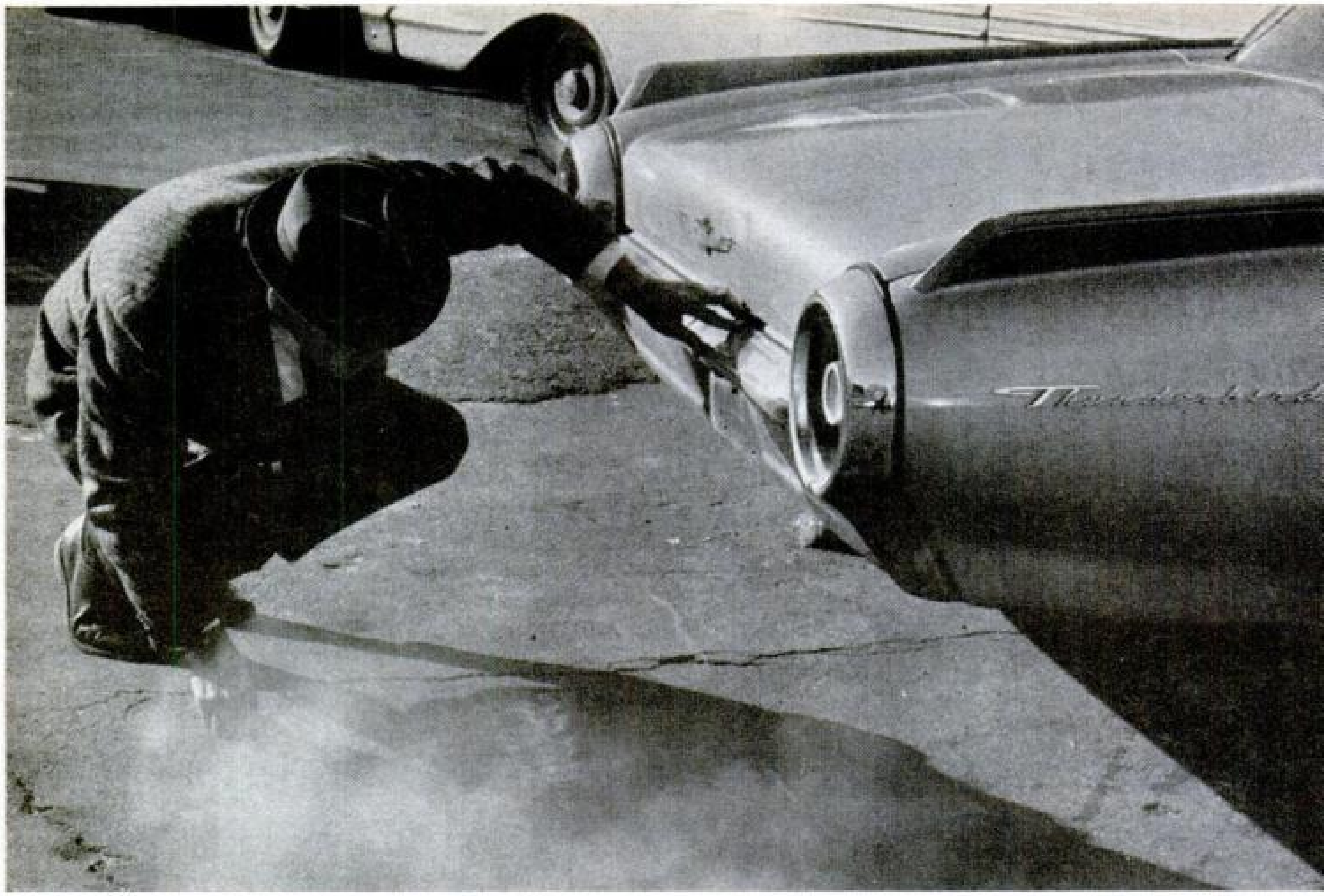

Exhaust smoke will tell you a tale. Black smoke from this T-Bird indicates too rich a mixture caused by bad automatic-choke adjustment. Bluish smoke would mean engine is burning excessive oil because of worn valve guides or piston rings. Make test with warm engine.

HOW TO BUY A

Just a few simple tests will help you separate the dogs from the cream puffs. Follow up on-the-lot inspection with a lift-and-workbench session at your own service station

By Bill Taylor

A door that fits poorly indicates possible body misalignment from an accident. Watch out for doors that open or close hard, or bind on hinges. Check window operation; those in rear doors of four-door hardtops and rear quarter of two-door hardtops often go sour.

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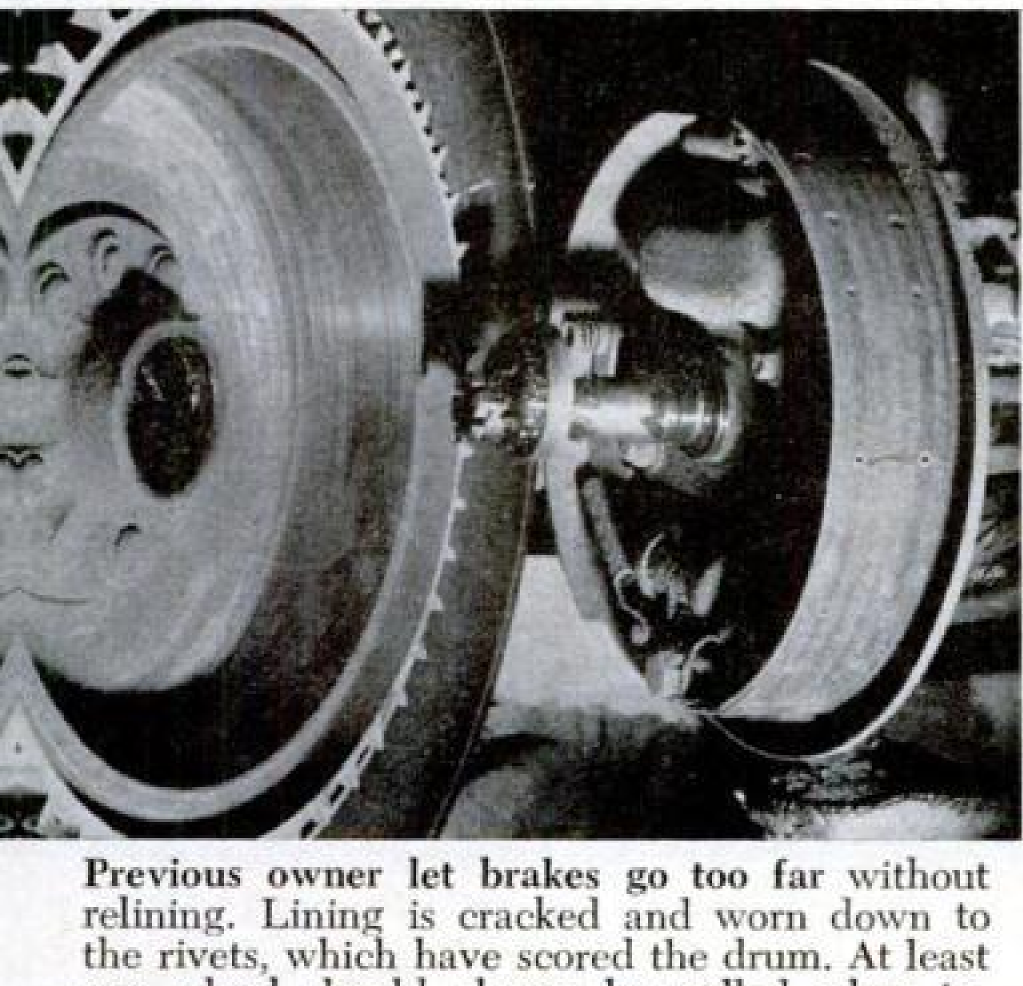
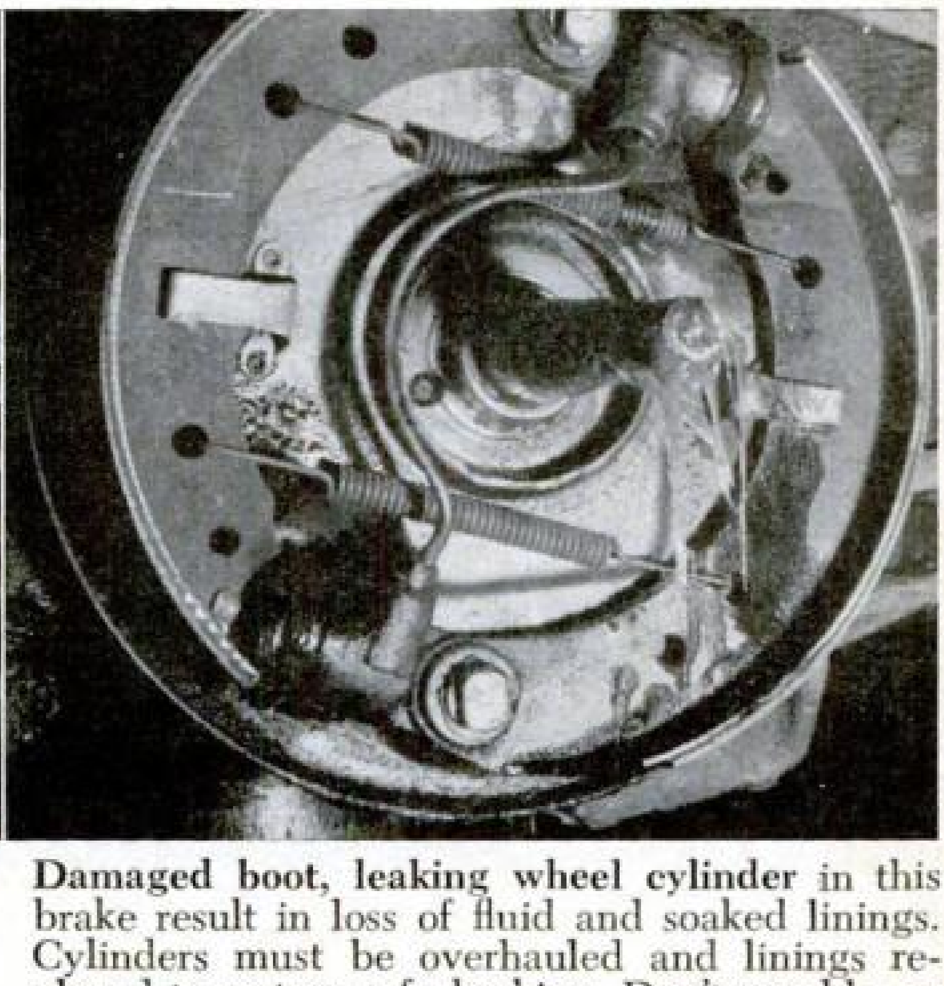
Telltale ripples often reveal a repair after body damage. Sight down side of the car. Running your hand over a suspected area may help find rough metal that escapes visual detection. Beware of a car that shows evidence of straightening of several of the major panels.

GOOD USED CAR



Previous owner let brakes go too far without relining. Lining is cracked and worn down to the rivets, which have scored the drum. At least one wheel should always be pulled when inspecting a used car. Avoid any dealer who objects to this kind of procedure.

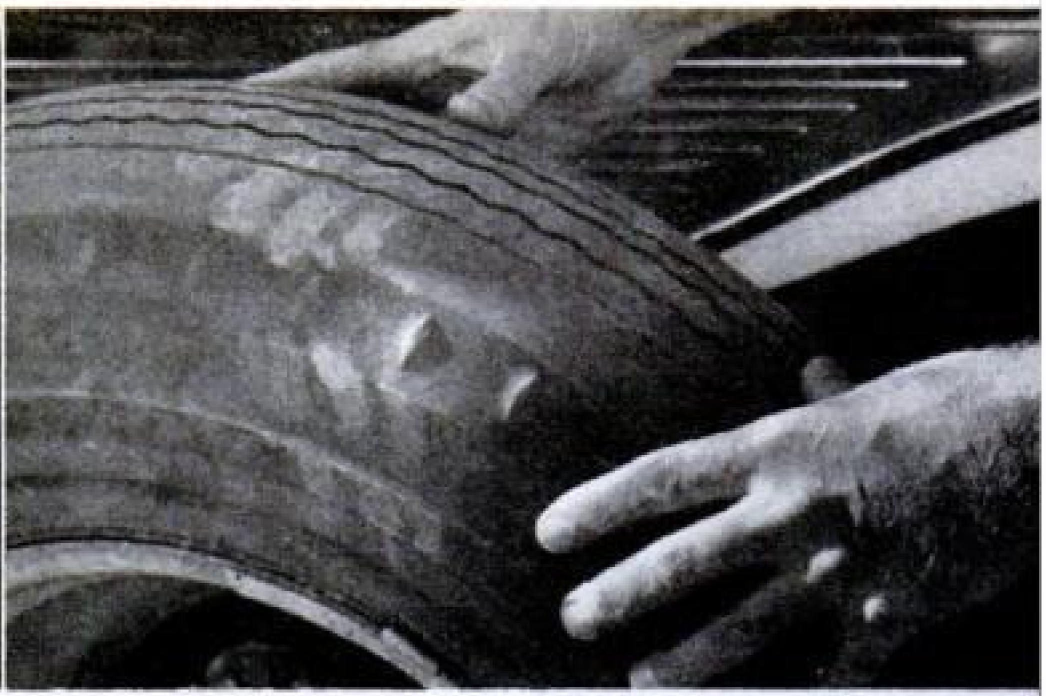


Damaged boot, leaking wheel cylinder in this brake result in loss of fluid and soaked linings. Cylinders must be overhauled and linings replaced to restore safe braking. Don't gamble on brakes in this condition. A good dealer will make repairs if you request it.

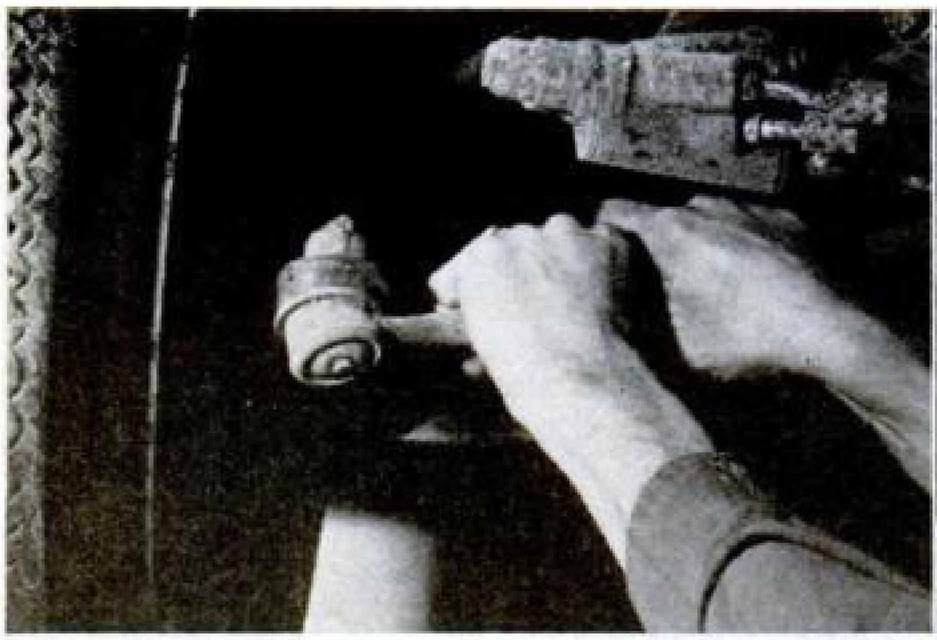
CONTINUED

Urheberrechtlich geschütztes Material

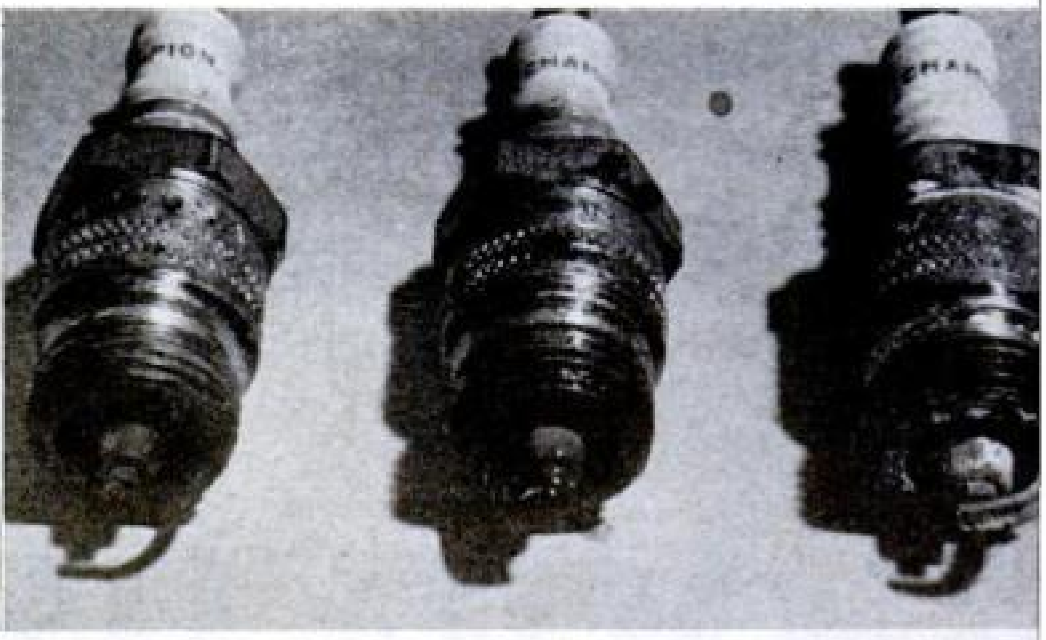
A more complete checkup on a lift by your own mechanic is a must if car passes inspection on lot. Shake a front wheel from side to side—more than a quarter-inch of play indicates worn bearings or ball joints. Watch for unusual noises. vibration, and sloppy steering.



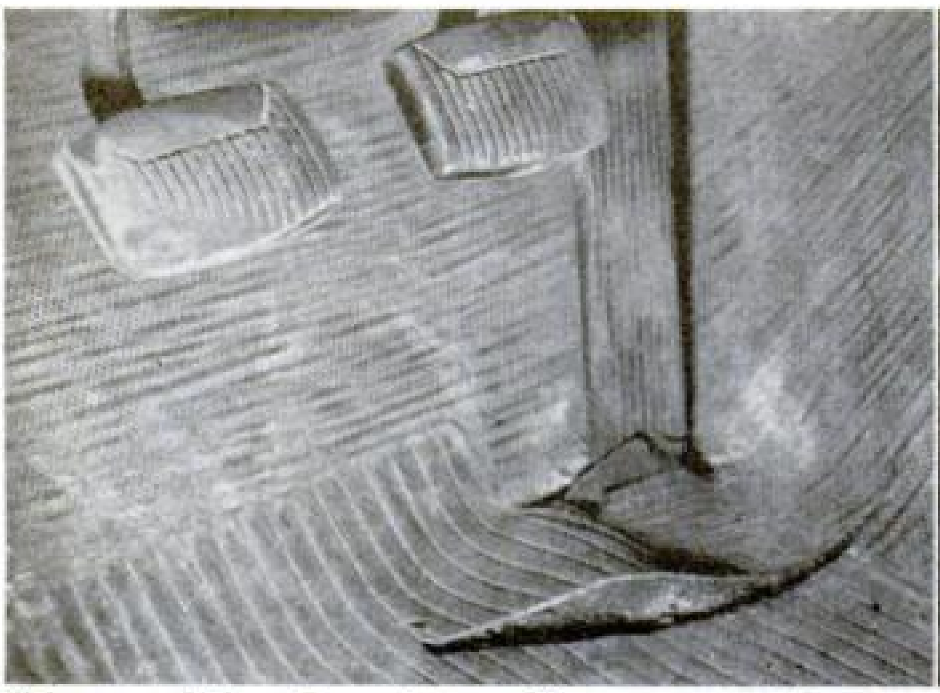
Rounded shoulders of this spare came from hard cornering—abuse by previous owner. Examine all the tires—they can indicate faulty front-end alignment, worn components in suspension. If tread is cupped or worn unevenly, wheels need realignment. Insist on balancing.



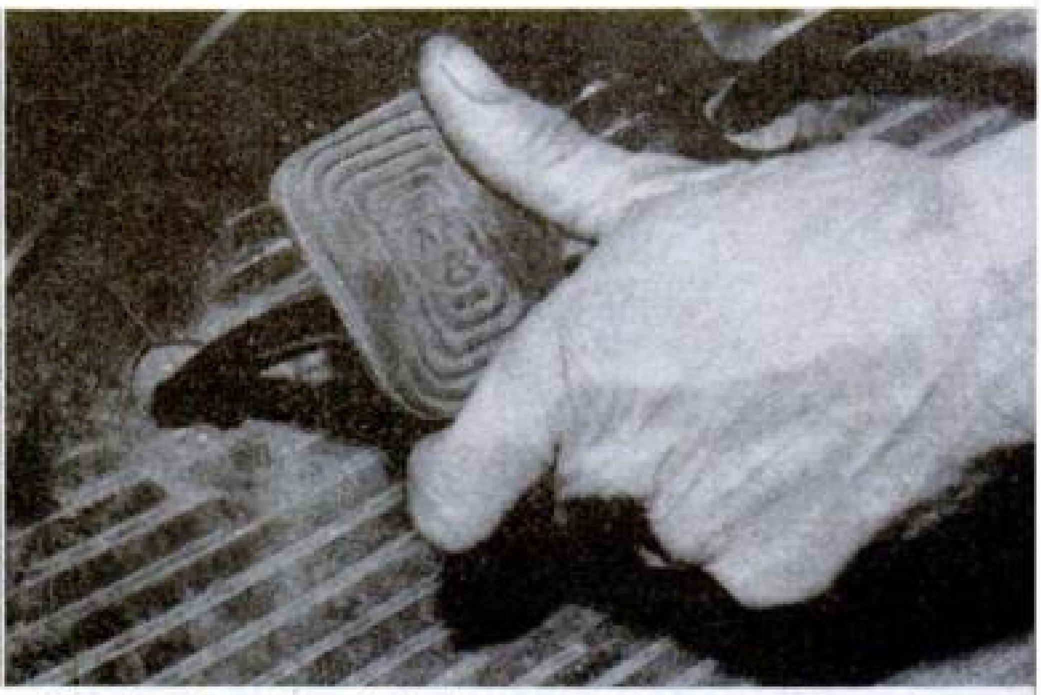
Shake the tie rod both vertically and horizontally, holding it near end. Excessive play points to worn ball-and-socket joints. If joints are sealed, be sure they are undamaged. Also make a careful search for loose or broken mountings at shock absorber and sway bar.



Spark-plug deposits can clue you in on condition of engine. Rich mixture, possibly low operating temperature deposited soot on plug at left. Oily coating on center plug was due to high oil consumption. Blistered plug on right means excess heat, too lean a mixture.



Worn pedal pads and torn floor mat in this car belie a low reading on the odometer. Be suspicious of brand-new pedal covers and mats in a car showing low mileage. Most dealers regularly set back odometers. (See "Can We Stamp Out Speedometer Rigging?" PS, Jan '61.)



Check clutch-pedal free travel in cars with manual transmissions. Pedal should move about an inch before resistance is felt. Insufficient travel indicates clutch facings are worn. If there is too much play, clutch may not release completely. Result: gear clash.

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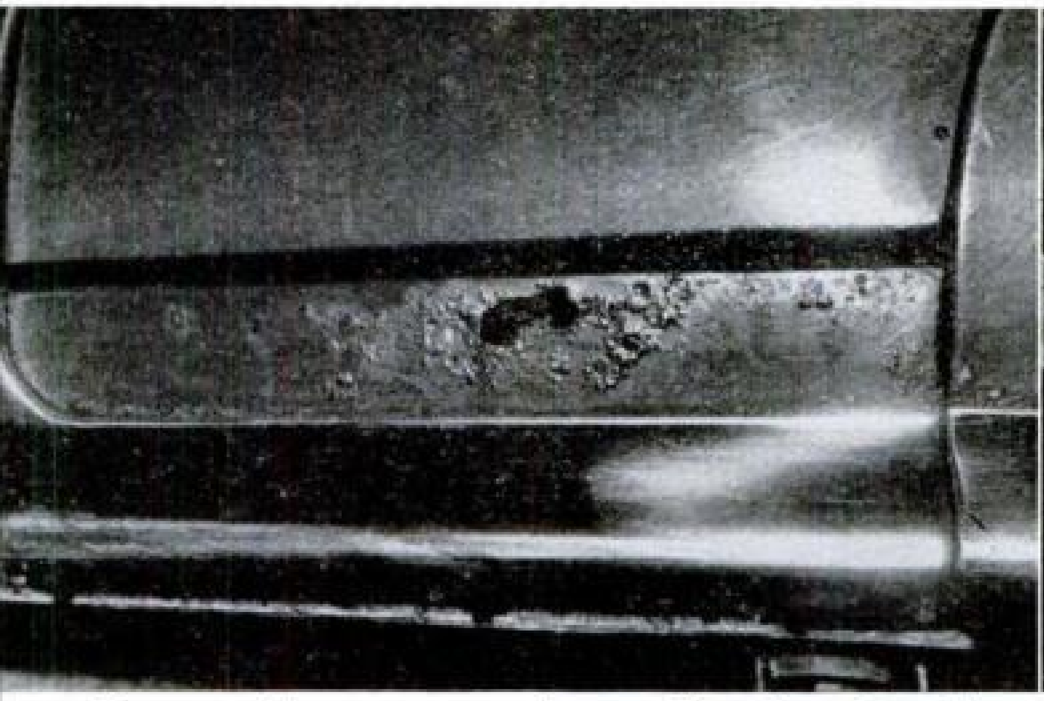
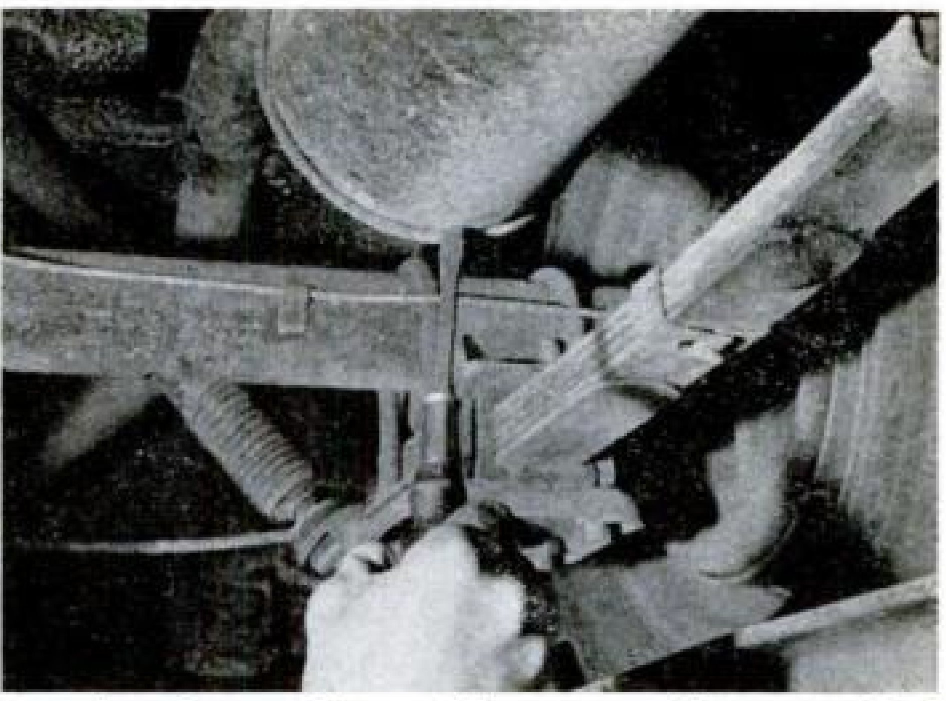
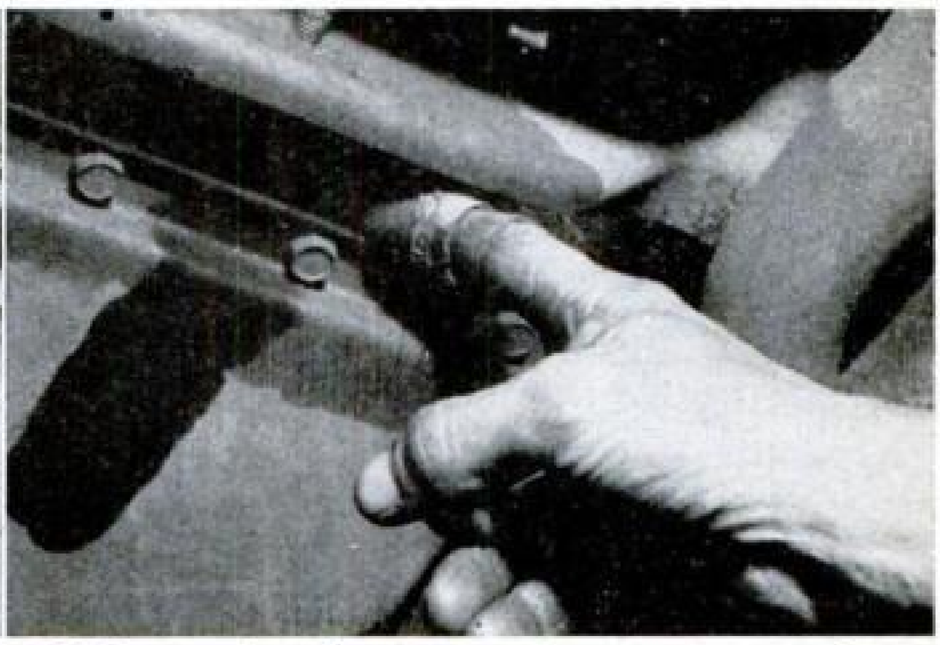


Inspect for rust on the underside of rocker panels, doors, and fenders. Always unsightly, rusted areas are critical in bodies of unitized construction—they weaken structural members. Corrosion often starts in places you can't see unless the car is put on lift.



Probe the muffler with a screwdriver to find corrosion. Thin areas will sound different when tapped, and metal may yield under pressure. Joint between head and shell is trouble spot. On cars with dual exhausts, look for rust on muffler on "cold" side during warmup.

Heavy sludge inside a rocker-arm cover could be caused by clogged crankcase vent system, worn rings, or just short trips at low temperature. If sludge feels tacky and can be wiped off with a wet rag, it contains ethylene glycol, indicating an internal coolant leak.



Fluid running down rear of transmission-oil pan indicates leaking rear seal. Check area around flywheel housing for front-seal leakage. If you're in doubt about source of oil—transmission or engine—a special red dye can be added to engine oil for identification.

Rust or slime in radiator filler neck are tip-off system was serviced badly, needs thorough cleaning. Excessive rust at low mileage points to leakage of air or exhaust into coolant. If oil is present, most likely cause is the leaking of transmission cooler into the radiator.

Be sure you understand terms of warranty—get it in writing—once you have picked your car. Most dealers offer a standard 30-day, "50-50" agreement. Dealer and buyer split the cost of labor and material required for any repairs within 30 days after the car is bought. ■ ■

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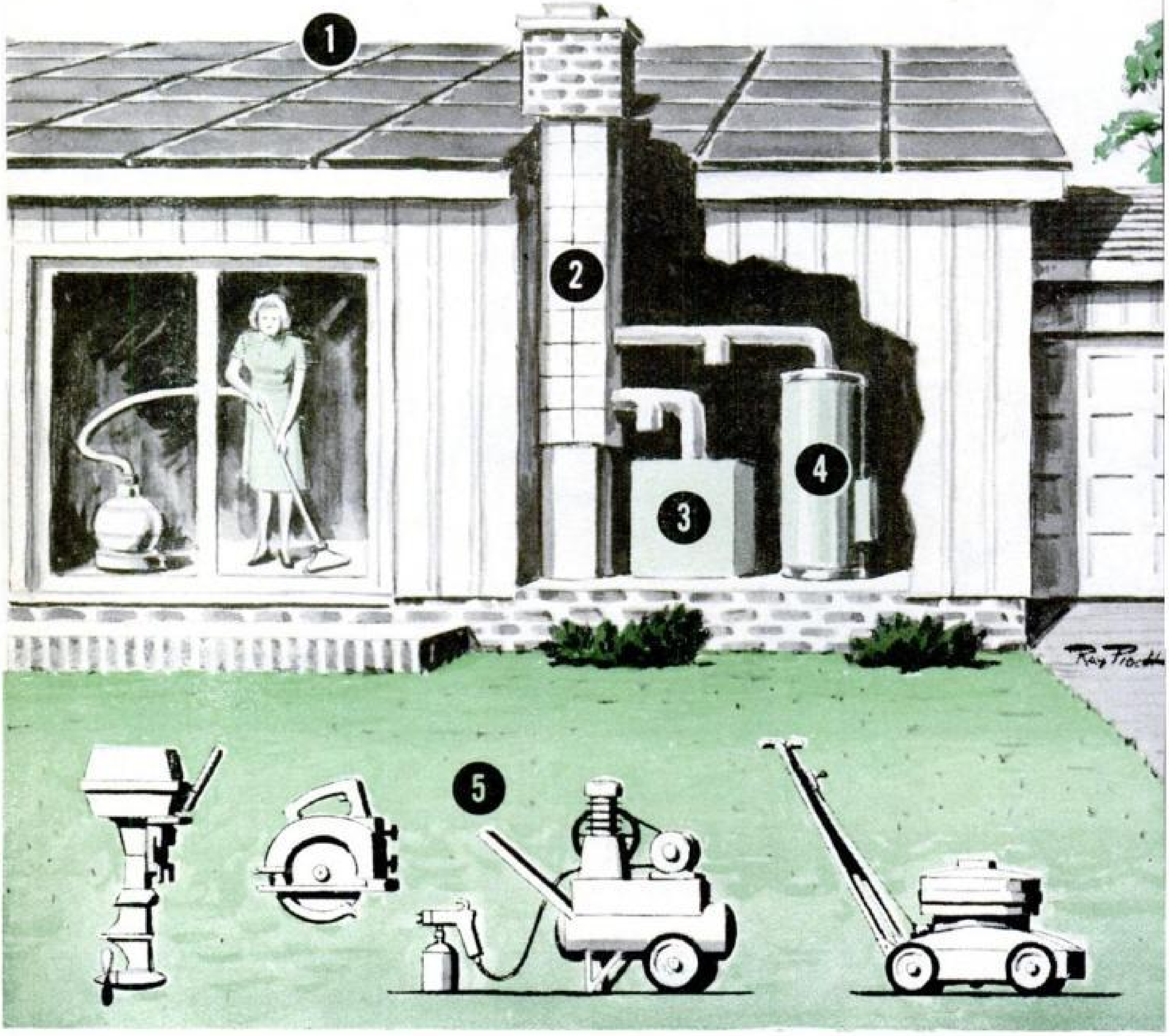
AMAZING NEW



Most appliances will be self-powered; you may even

By Martin Mann

IF YOU take a close look at the pilot light of your gas water heater, you'll see its flame surrounding a small metal can, cherry-red-hot. That can is an electric generator. This homely little gadget, making electricity directly from heat, is only one of a large and varied family of devices to produce electrical power. What they will do to your way of living can now only be guessed at.

Many experts predict electric cars by the 1970s, and much smaller electric bills —you might even eliminate the utility bill entirely by generating your own power at home.

Most machines, saws to vacuums, will run on long-lasting built-in batteries.

Lawn mowers, outboards, and carts

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FOR YOUR HOME

Solar cells built into the roofing (1) will convert sunlight into electricity during the day and store it for night-time use in fuel cells. Your chimney will be wrapped with heat-converting thermoelectric cells (2) to supply electricity for the heating units (3 & 4). Indoor and outdoor appliances (5) will have no power lines, instead will be self-powered by their own fuel cells.

FOR YOUR CAR

Fuel cell (6) that makes electricity from a reaction between liquid petroleum gas (7) and oxygen (8) will power your car of the future. Each wheel will have its own motor (9), wired to fuel cells. Thermoelectric cells creating electricity from body heat will power radio (10).

generate your own electric power at home

will also run quietly and smoothly on their own self-contained electric power plants.

Revolution in electricity. It has been brewing since the race for the moon spurred research into exotic power sources. Every conceivable technique for generating electrical power, from electric eels on up, is being investigated. Of the many new ideas under test, three —each completely different—are about to give old-fashioned dynamos and batteries a run for the money:

• *Direct converters* change light or heat energy straight into electric energy without reacting chemicals (as in batteries) or moving parts (as in dynamos). These thermoelectric, thermionic, and solar cells are made of materials like the stuff in transistors, which spew out elec-

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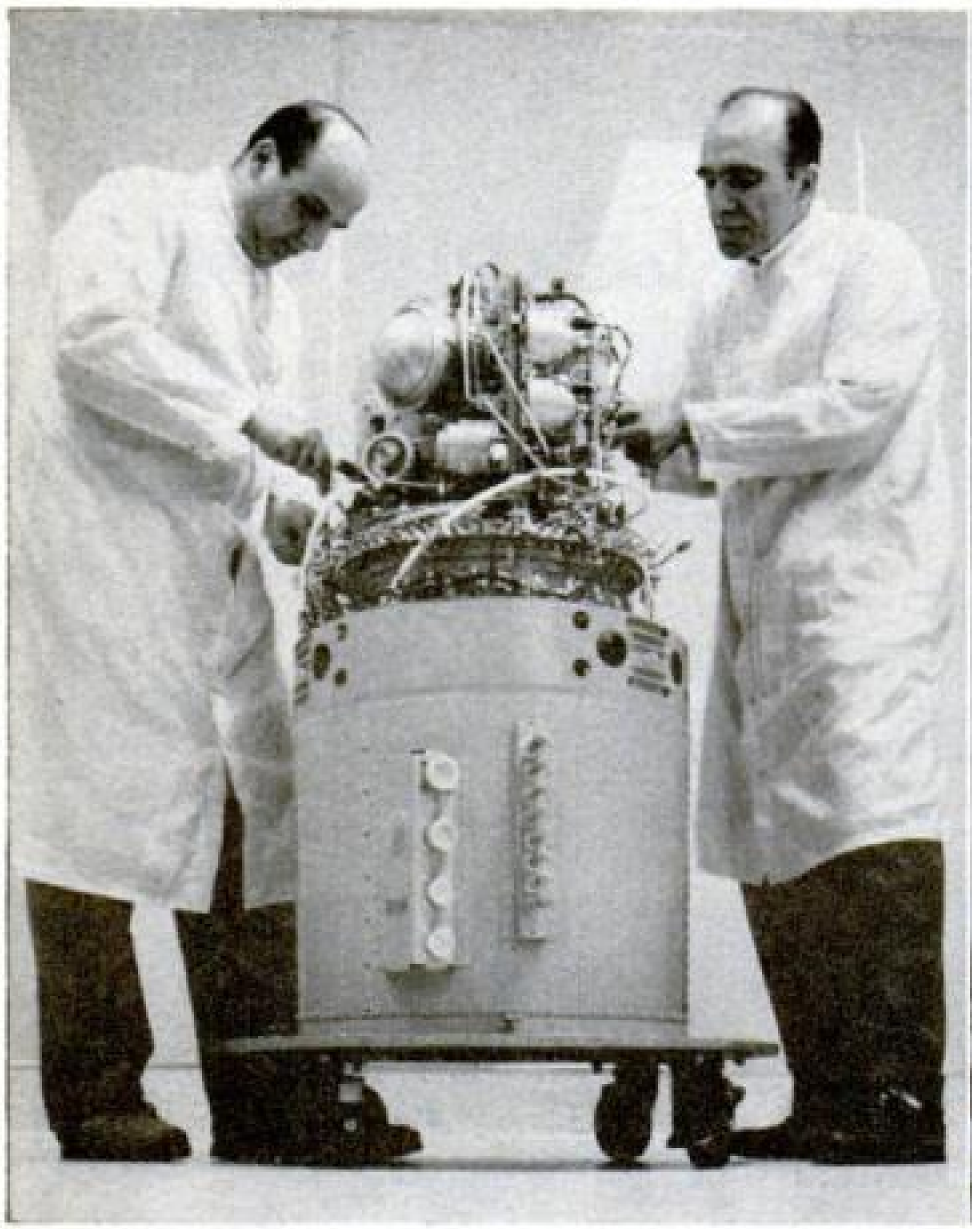
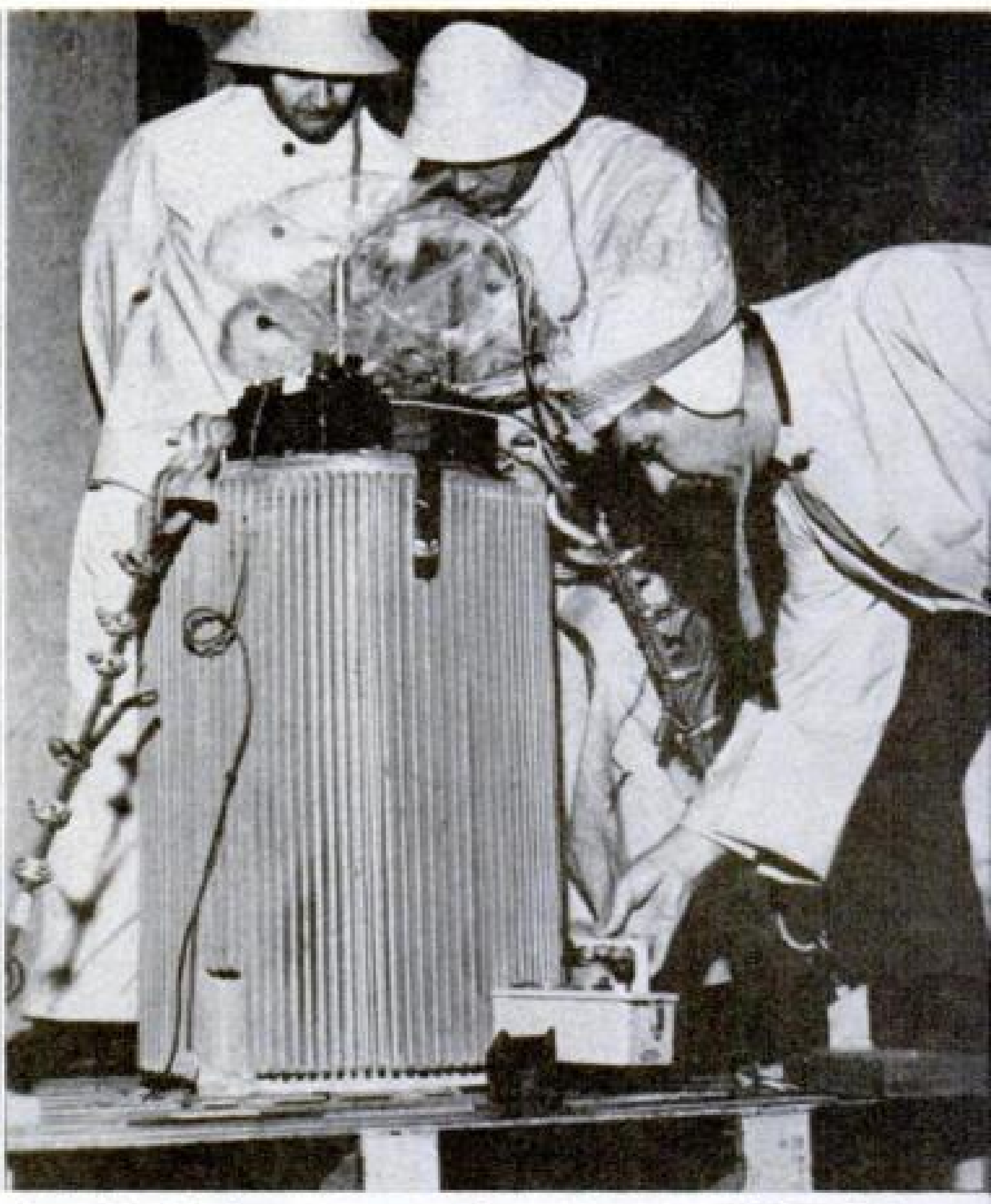
Experimental models of these revolutionary new power



Prototype of fuel cell destined to provide electric power for the first Apollo space craft is being assembled by Pratt & Whitney Aircraft technicians. A by-product of the cell's reaction process: pure water that astronauts could drink.



Atomic fuel generates electricity in SNAP-7D manufactured by the Martin Company. It's a 60-watt generator that turns heat from strontium-90 decay into electricity to power robot radios that make automatic weather reports.

tricity if you heat them or shine light on them.

- *Fuel cells* are chemical batteries that never burn out and never need recharging. They produce electricity by reacting a fuel (such as hydrogen) with an oxidizer (such as pure oxygen or air), and they keep making electricity steadily as long as they are fed fuel and oxidizer.
- *MHD* is short for magnetohydrodynamic generator, a dynamo without moving mechanical parts. Instead of a spinning rotor, it uses a rushing blast of very hot, electrified gas to induce electrical currents.

Even today these exotic sources of power are at work, in a few cases to run the ordinary machines of everyday life, more often to operate military devices and spaceship equipment.

The big impact for tomorrow will be on your car. Ever since the day of the horseless carriage, engineers have known that the only sensible drive for cars was electric. Electric motors make little noise and no smell. They contain few parts—none reciprocating—so they are economical to manufacture and they practically never wear out.

More important to you when you step into your electrified car will be the operating differences. Turn the key and it starts instantly—electric motors aren't fazed by the weather.

Press the accelerator and away you go—no shifting. Electric motors automatically adjust their driving force to the load, pulling hard to start up or climb hills and purring lightly for high-speed straightaways. They do not require gearboxes or torque converters.

Snow and ice driving will become easier. Electric motors can be made effective and efficient in small sizes. So each wheel could carry its own separate motor. This would not only add the surefootedness of four-wheel traction,

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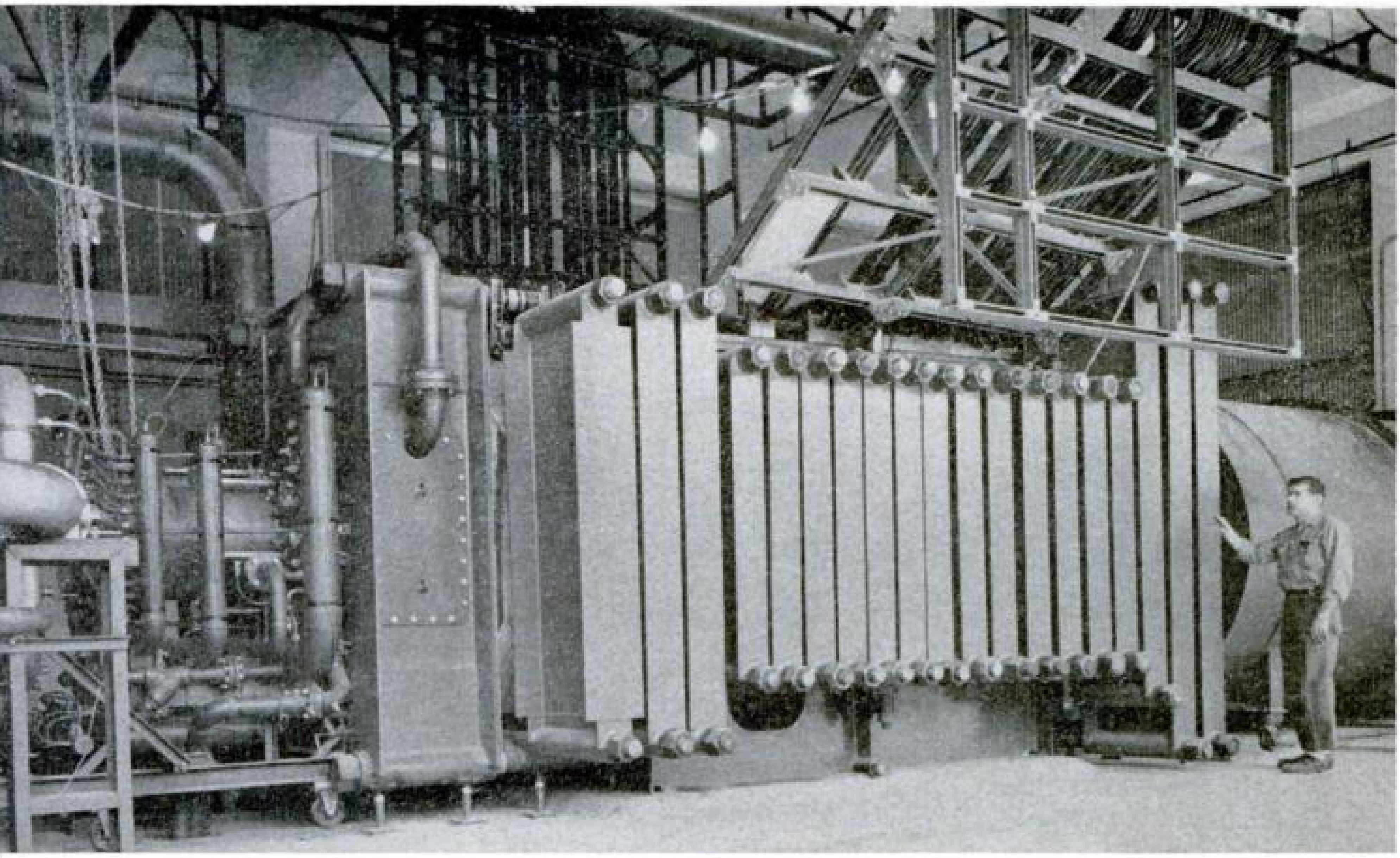
sources already have been built—and they work



An experimental magnetohydrodynamic (MHD) generator at the Avco Research Laboratory, Everett, Mass., has already produced more than 11,000,000 watts—has the potential to produce 35,000,000 for three-minute bursts. The new-type generator creates electricity from the interaction of an ionized gas and a magnetic field. It is intended to produce bursts of very high power for military projects, but such generators may eventually provide electricity for cities.

but it would completely eliminate the drive train—no shafts, differentials, or anything except wires.

What has kept such a paragon among vehicles off the road—until now—is the lack of electricity to run its motors. You can't plug it into a utility system without tying it to trolley wires. Batteries are too costly, too heavy, and too feeble to run far without recharging.

What fuel cells can do. They are changing the picture. These cells are radically new kinds of batteries, like the one built to power our moon-bound spaceship. The fuel cell promises to make the electric car a reality. It's economical, lightweight, and best of all, it never runs down.

Small fuel cells could also bring new kinds of electrical conveniences to your home. But a better possibility here are the direct converters. They are already performing superman-size jobs in space satellites and weather stations.

In the Antarctic, a direct converter is powering a steel-encased radio transmitter that automatically sends out temperature readings every six hours. Its power comes from an atomic heat-to-electricity converter: 60 shiny buttons of lead telluride surrounding four capsules of radioactive strontium-90. The constantly disintegrating strontium atoms throw off heat to maintain a temperature of 800 degrees F, while the telluride buttons convert the heat directly into 10 watts of electrical output. The buttons are thermoelectric elements, which generate electricity—quietly, steadily—so long as one side is hotter than the other. Since the thermoelectric elements never wear out, and the strontium-90 "burns" itself up very slowly (half-gone in 28 years), this unit can produce electricity continuously for years without recharging or any attention at all.

Direct converters mean that the sub-

[*Continued on page 192*]

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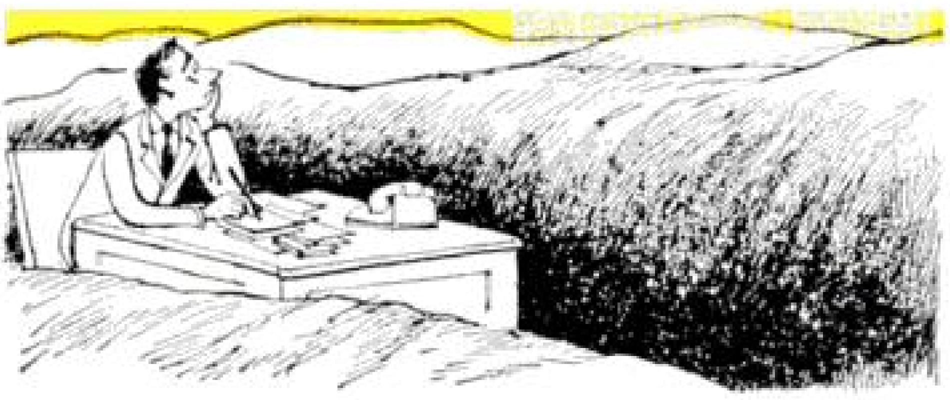
Are you on the "wrong track"?



Feel you're in a rut?

How to Get Out of a

IF YOUR job is getting you nowhere, it's costing you plenty—in money and frustration. You have two choices: You can suffer with a dead-end job or, by taking a closer look at your stumbling blocks, turn them into stepping stones to success.

Gil Jones is a good example of how some men resist going into what they would really like to do:

Gil (in his twenties) knows more about how to make and fix things around a house than almost anyone in town. He gives advice and help to friends without charge, even though his regular job as a retail clerk doesn't pay much. When someone suggests that he go into the repair business, the prospect excites him temporarily—then appalls him. He has never done anything like that before! How would he go about it? Sure, people come to him for help and offer to pay, but he's not a carpenter, or a plumber, or a painter. His friends tell him plenty of customers would come to him if he made a business of it. But where would he start? No, that would take more business savvy than he has. Yes . . . but . . . well, maybe . . .

Gil has reached a dead end. He wants to do something bigger and more exciting than he's doing. But he's held back by his lack of confidence. Without realizing it, he has given up on himself.

Many of us tread water year after year: Either we're afraid or we don't know where to start. Too much self-doubt blinds us to opportunities all around us.

When you get bogged down

There are several circumstances that make the dead-end feeling especially severe:

1. Realization that you failed to make your start in a satisfying occupation. There is a myth that every high-school graduate should know what he wants to do and set about doing it. The truth is that very few have had enough experience to make career decisions, yet they are under pressure to do so. Some are lucky enough to fall into something they like. Others take a job simply because it is "there."

2. After a fine start, finding yourself on the wrong track or going in circles. It is not unusual to find people who have gone through college, but who are still not sure they are in the right field. One of the major problems as you come to maturity is to determine who you are, what you are going to be, and what occupational track you are going to follow.

3. Gratifying progress for a time, then a leveling off in a barely comfortable rut. You have no reason to be dissatisfied—you've done very well—but you live

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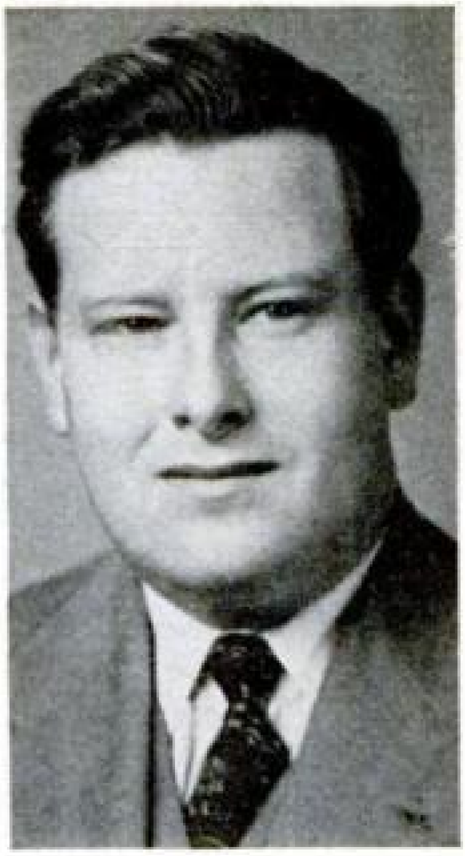
No satisfaction from your work?

The author is director of the Industrial Mental Health Division of the Menninger Foundation, Topeka, Kans., and personnel consultant to corporations and to the Foreign Service Institute of the State Department



Dead-End Job

By Dr. Harry Levinson

with the feeling that there'd be more to enjoy if only you could start over.

Where it hits hardest

The most difficult time to escape the dead-end feeling seems to be when you're between 25 and 35, have been out of school or college more than seven years, and have tried several jobs. You recognize that after these years of experimenting, you're facing your own hour of decision—and time is running out. Employers will expect you to be experienced in some trade or skill. A college diploma doesn't necessarily eliminate the problem.

If you are not happy with your work, should you settle for what you have and resign yourself to it for the rest of your life? The answer, of course, is no.

What you can do about it

What you must do is to use more of your potential:

• *Find a model.* The successful man often mentions somebody along the way whom he admired and who encouraged him. This doesn't mean that everyone who picks a good model becomes equally successful. But you must learn how to apply your abilities, and that requires a good teacher. People without such a model often seem to lack direction.

Look for someone, then, who can serve as a model in your field. If possible, tell him that you want to learn from his experience. Find out what steps he took to get where he is and what problems he encountered. See how his business or occupational world looks through his eyes, what pitfalls must be avoided.

• *Seek vocational guidance.* Some communities have private guidance bureaus. For a relatively modest fee, they will give you psychological tests and interpret for you where your skills or talents lie. Such services are provided under the auspices of the YMCA and fraternal lodges in some cities.

The American Personnel and Guidance Assn. (1605 New Hampshire Ave. N.W., Washington 9, D.C.) will tell you which are reliable. Sometimes such services are available in college education departments. Vocational guidance will not only help assess your capacities and abilities, but it will also keep you from going off on the wrong track and wasting time in an area not for you.

• *Lay out a plan for self-development.* Include your goal and the steps to reach it. Find out whether courses can be taken at night school or by correspondence, and whether scholarships are available. Maybe your company will pay for completed courses.

Your biggest handicap is self-doubt.

[Continued on page 194]

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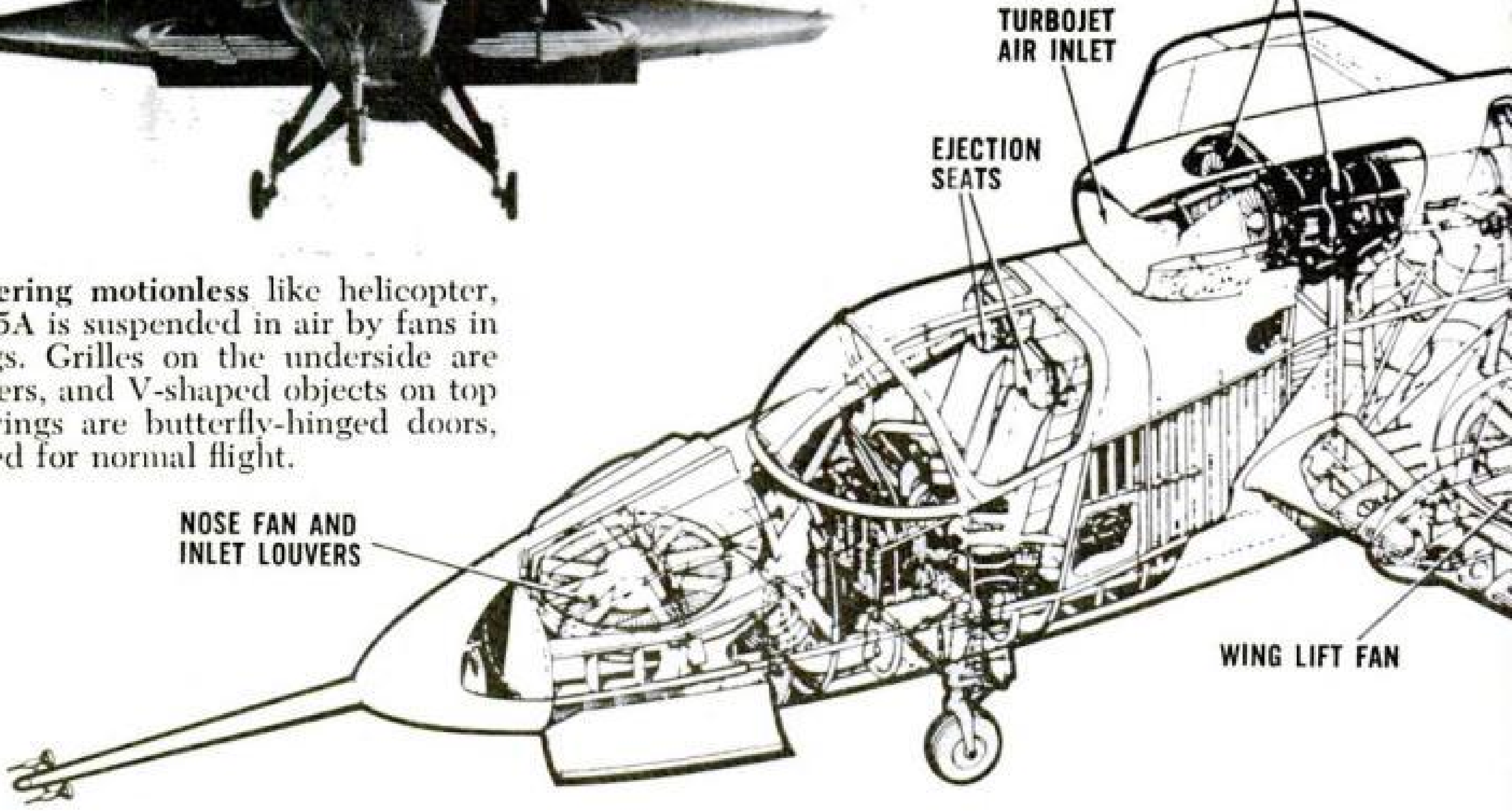
GOING UP: Takeoff varies from exact vertical by only few feet as shown in one of the tests at

Takes off straight up, lands straight

Hovering motionless like helicopter, XV-5A is suspended in air by fans in wings. Grilles on the underside are louvers, and V-shaped objects on top of wings are butterfly-hinged doors, closed for normal flight.



Lou Everett, Ryan test pilot, holds conventional control stick. All cockpit controls and instruments are of kind used by fixed-wing and helicopter pilots. Transition from vertical and forward flight is made without shifting foot or hand position.

The Army's new XV-5A takes off vertically or from a short landing field and flies at near the speed of sound at treetop level or an altitude of 35,000 feet. It can hover like a helicopter and land on a dime.

Powered by two GE J85 turbojets and built by Ryan, the lift-fan plane gets lift from thrust diverted to wing fans also developed by GE. A third turbofan in the nose provides lift and pitch control. In transition to horizontal flight, diverter valves redirect all the jet stream through the tailpipes. Vanes under the

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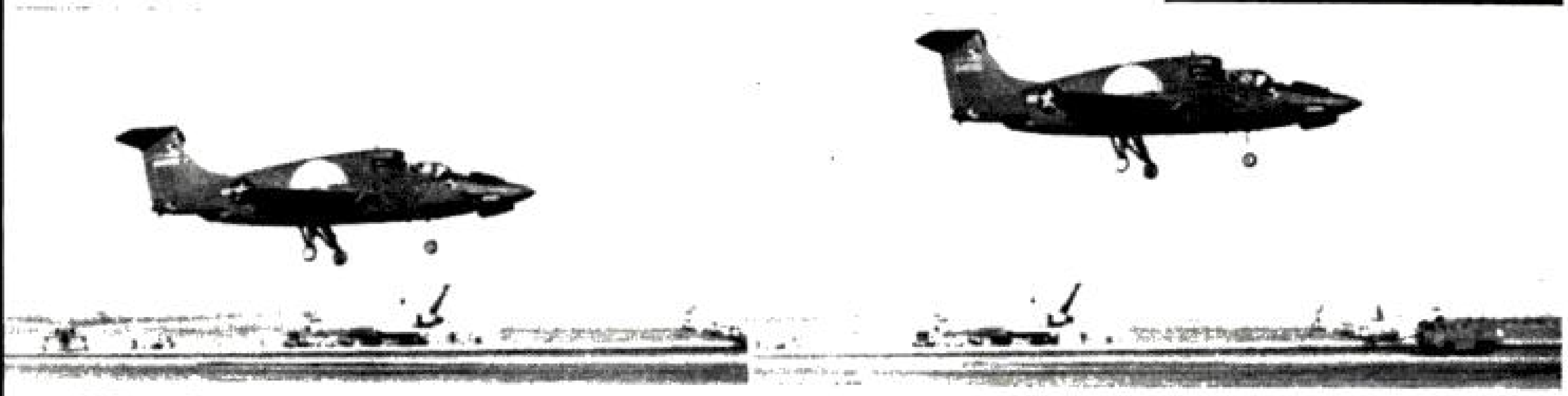
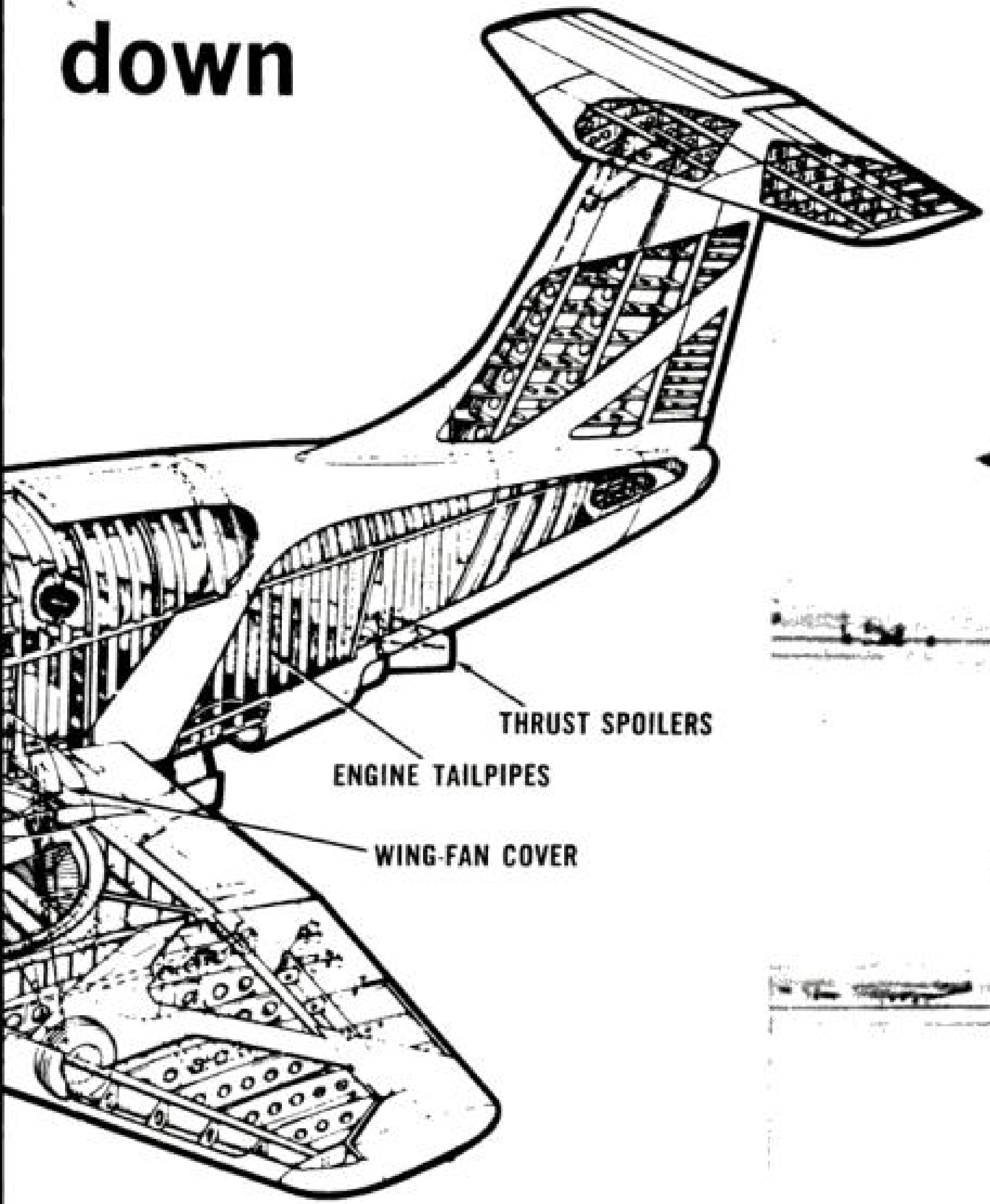
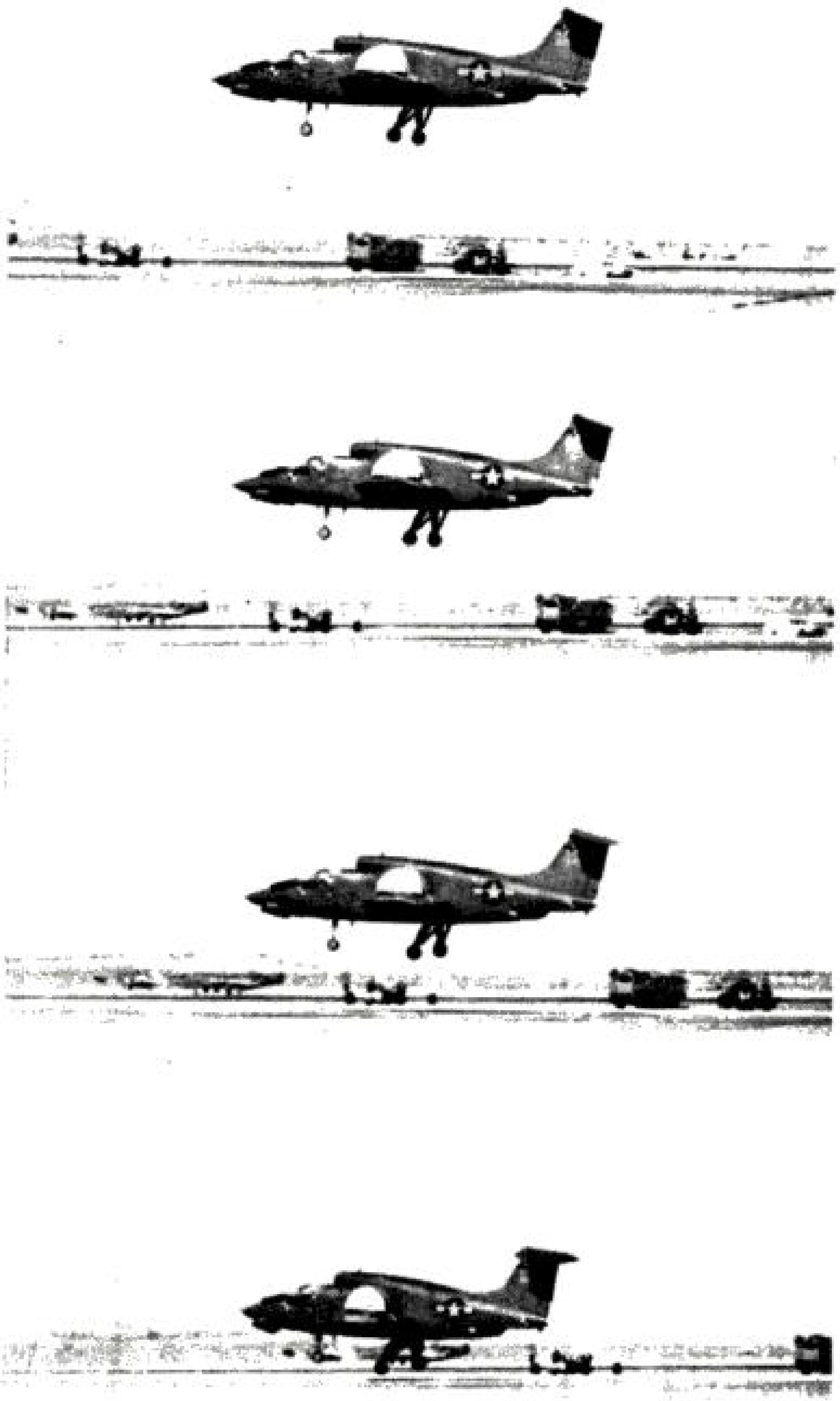


Edwards Air Force Base, Calif. Note as reference points stationary cars and planes in background.

down



COMING DOWN: Plane, seen over truck in top photo, moves just beyond group (bottom photo) short distance away.



wing fans are first angled, then closed, and butterfly lids on top are shut to provide an airfoil surface. Transition to normal flight can be made at level altitude or in climb.

Basic thrust of the two engines is 5,316 pounds, nearly tripled in lift power by accelerating the exhaust when diverting to the wing fans.

The XV-5A is rated at Mach 0.72 at sea level (548 m.p.h.), Mach 0.77 at 25,000 feet, and can maintain an average of Mach 0.7 at 35,000 feet for a distance of up to 1,225 miles.

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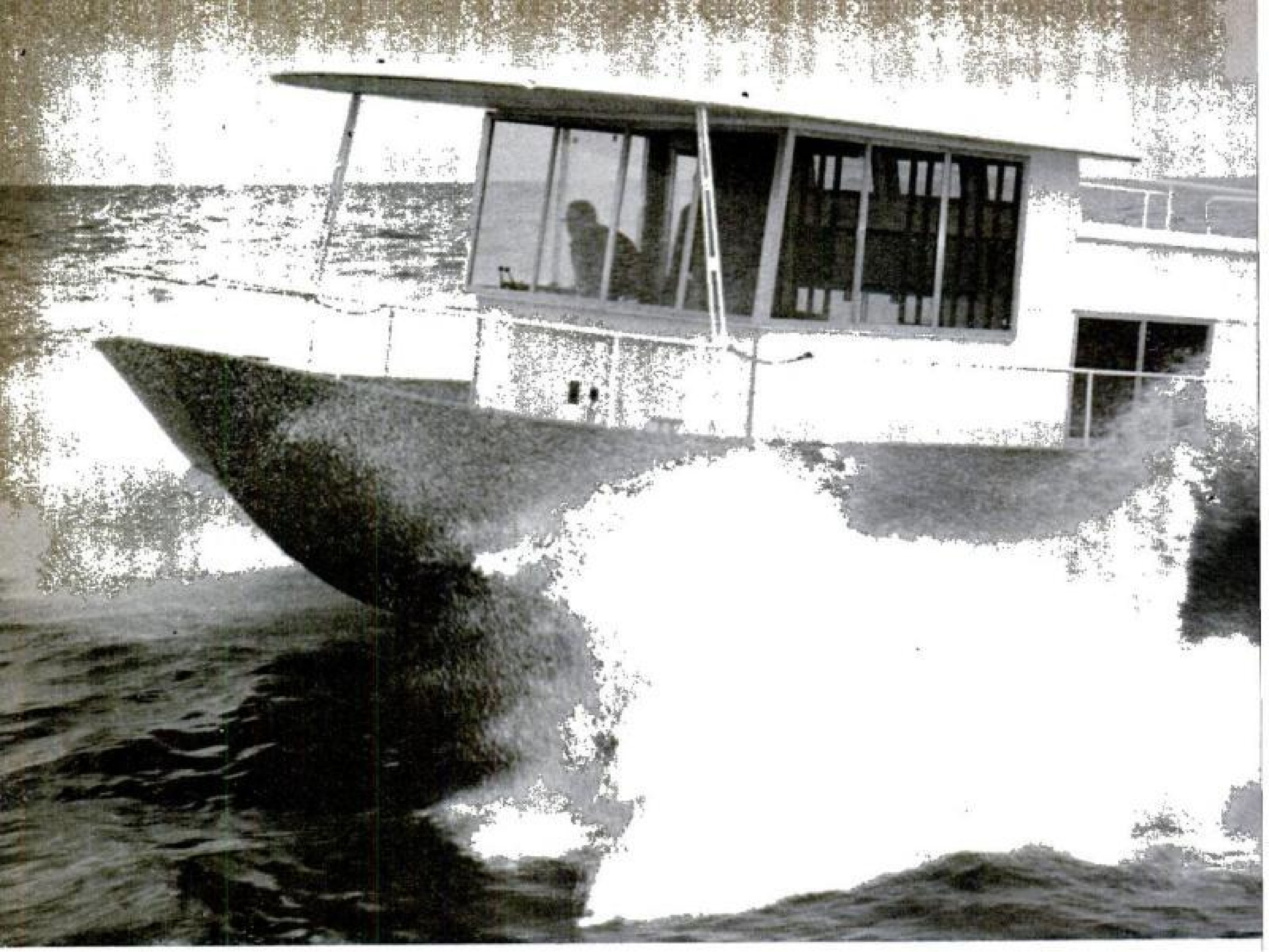
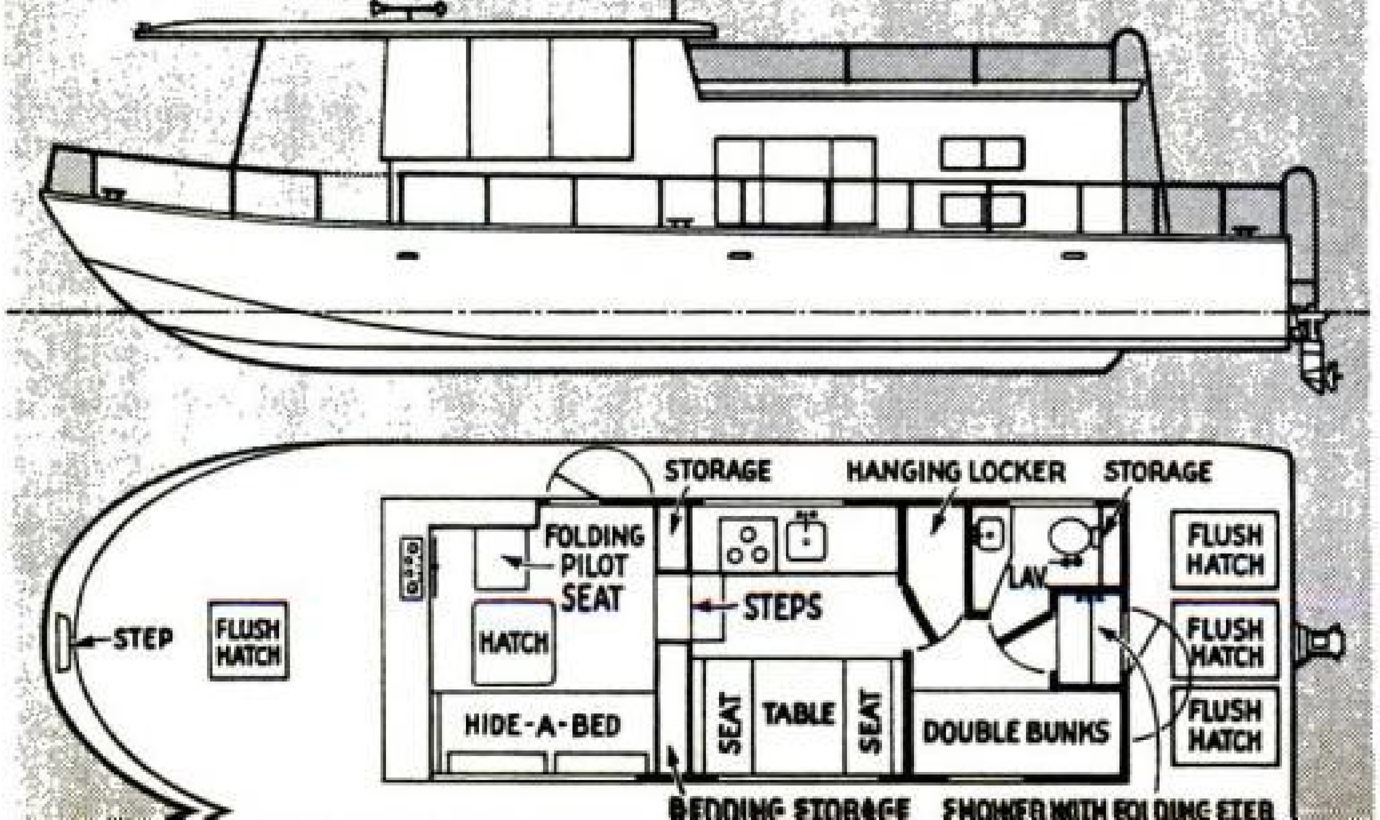


Want to place in the money in big-water boat races without leaving your living room? Then the River Queen is the boat for you

HOT-ROD

LAST summer Lake Michigan fish ducked fast as unlimited-power racers passed over their heads in the Lake's first big-time powerboat race in years. The course was over 100 miles—from New Buffalo (Mich.) to the Chicago waterfront, and return. And every skipper and crewman hot out there to win.

The big-boat racing fraternity took the occasion so seriously that they brought in boats and crews from the Miami-Nassau race fleet. No one was surprised when



Floor plan of the River Queen shows careful planning to give privacy aboard. Handily placed doors close off entire after-cabin complex to give plenty of dressing room. Hanging locker is head high. Shower stall is all enclosed. Amidships, there is a complete galley and dinette. Forward cabin serves as pilot house and also contains a divan that unfolds into double bed.

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◀**Making a big splash,** the River Queen enters the choppy Saugatuck Channel from Lake Michigan at full speed. And she drove straight and true even in this rough water.

Complete control system is right in the living room. Wide-spaced stern-drive units give you outboard-type control combined with the maneuverability of a twin-screw inboard.

The engines are isolated in their own compartment, separate from the rest of the bilge. This means dry bilge forward for handy storage, and it also affords protection against fumes.

PS BOATING

HOUSEBOAT

By Jim Roe

Miami-Nassau winner Odell Lewis won the Lake Michigan race, clocking an average speed of 60 m.p.h.

But you only had to move two steps down in the standings to find the big surprise that raised boatmen's eyebrows everywhere: Competing with the hopped-up-horsepower fleet of stripped-down race boats, a houseboat handily placed third.

You name it! Houseboats have never been known for their hustling ability. Clearly, this one—the River Queen—was a new breed of boat. It was equally clear that I'd have to take a look from the driver's seat to see what makes it tick so fast.

We couldn't have picked a better day to test a boat with a house on it. It was November; foggy, dark, damp, and cool. Just the sort of day to stay inside a house, and we did; only this house was headed out into a choppy Lake Michigan. I had the twin Chrysler 210s at the full-out 4,000-plus r.p.m., and no intention of slowing down to ease our way over the extra chop just outside the Saugatuck light.

There was nothing to it—except a bit of spray flew here and there. You can't introduce a 38-foot, 7-ton projectile into a strong Lake Michigan chop at 30 m.p.h. and have a glass-like sea. But the River Queen abundantly proved herself the queen of the Lake, too. Off the murky shoreline, I tried maneuver after maneuver: Into the seas, parallel to them, from astern, and off our quarter. I made tight 360-degree turns at high speed. Considering the sea conditions, there was literally no roll, no pounding.

Better yet, in the damp chill of a Midwest November day, we were comfortably installed in the large, airy and warm, com-

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Urheberrechtlich geschütztes Material

Electrical control panel just forward of helmsman's position controls all current aboard. A special transformer converts dockside current for use in boat's 12-volt fixtures, pumps.

Solid comfort! The divan in the River Queen's main cabin unfolds to reveal a genuine mattress as comfortable as the one at home. Even with double bed open there's room to walk about.

bination living-room-pilot-house. This is a boat that takes a lot of the comforts of home to any place you can find a couple of feet of water.

Come aboard and look her over. A good place to start is at the extreme forward end of the bow. A handy gate in the rail and a firm step enable you to come aboard merely by nuzzling the bow up to a dock or a bank. Standing on deck, your first impression of the River Queen is one of strength and solidity. The hull of all-welded, heavy, steel plate is built to take it, and feels like it. The hull shape is semi-round, with a V-shaped box keel commencing near the bow and extending to a point about eight feet short of the stern. This keel is 18 inches wide at its point of hull attachment, and is a foot deep. A big overhang of the roof forward of the cabin shades and shelters a large portion of this "front porch."

You walk along the side of the River Queen to enter the main cabin. Next in line, amidships, and down two steps is the galley and dinette area. A convertible dinette, which seats four, makes up into a sleeping area for two. Opposite it is the galley area with range burners, oven, sink, and refrigerator.

Turn toward the stern and you find more examples of ingenious design. Normally there is no door between the galley-dinette and the area containing the berths along the port side astern (see floor plan). But all one need do is open the door that normally closes off a full-length hanging locker so large that even a Fibber McGee would call it a closet. When this opened door shuts off the passage, the after end of the boat becomes a private compartment with the hanging locker, upper and lower bunks, toilet, shower, and room enough to walk around in. A second double-duty door closes off either the roomy marine-head area or the shower bath. The shower is installed handily in a stern passageway and a door at the stern end of the shower enclosure leads directly to the afterdeck.

A 12-gallon electric water heater supplies water for the galley and the shower. A shore connection for the water-fill tank is fitted with a bypass valve. This not only allows you to use unlimited water while a shoreside water supply is attached to the boat, but automatically fills the boat's water tank so that it is always ready to go when you want to shove off.

A large below-decks storage area provides plenty of room for extra gear. It stays bone-dry, too—a watertight bulkhead separates it completely from the engine compartment at the stern.

This engine compartment is served by three flush-deck hatches on the afterdeck. On the boat I tested, twin Chrysler 210-hp. engines were at port and starboard. Between these, there is plenty of room for the installation of a 110-volt generator.

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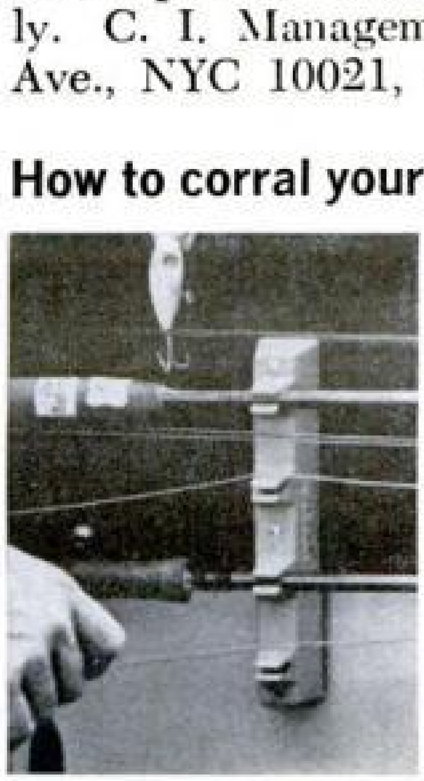
Sailfish Family Gets a Catfish

The Catfish, a brand-new cousin of the Sailfish and Sunfish, is a 13′-long catamaran with a beam of 6′. Maximum draft with centerboard down is 3′ 6″; minimum draft, 10″. She carries 105 square feet of sail for plenty of get-up-and-go. Built by Alcort, Inc., Waterbury, Conn.

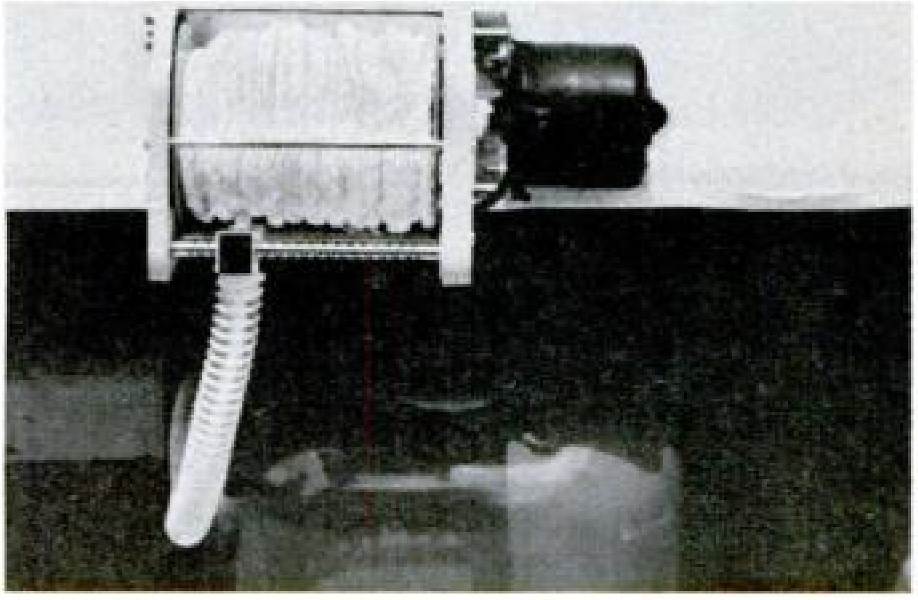
Boatman's binocular—it floats

Here's a German binocular that's sinkproof, waterproof, fogproof. The Stereofloat gives you three-dimensional vision with 8x30 magnification, but weighs less than a pound. The eyepieces focus internally. C. I. Management Co., 980 Madison Ave., NYC 10021, sells it in this country.

How to corral your fishing rods



One way to keep fishing rods from underfoot and in one piece is to tuck them into Strato Rod Hold'rs of weather-resistant vinyl. Attach a pair ($4.95) to your boat and they'll neatly end clutter. Strato Products, Tallmadge, Ohio.



Electric reel-in hauls in skiers

Push a button on the dash and Ski-Matic hauls in the ski rope for you. It cuts down frustration from knotty and tangled lines, and lessens the danger to other swimmers and to your own props from dragging lines. You can mount it in several locations, since pull is not directly at the reel, but against a knot in the rope at the transom. The 3½-pound reel holds over 100 feet of 3/16″ rope. About $40. Better Products, Inc., Pleasant Lake, Ind.

Urheberrechtlich geschütztes Material

Ability to tow a second vehicle—in this case a boat trailer—is an advantage of coach camper.

Which VACATION-ON-

Most of the comforts of home are incorporated these days in camping outfits—often of moderate price

By Lee Oertle

ANYONE, these days, can go camping on wheels. It's really getting cheap. A man and his family no longer are restricted to travel trailers and truck-mounted coach campers.

This spring, dealers will offer four other methods of camping—fold-out tent trailers, motor homes, bus campers, and cartop

BUYER'S GUIDE TO

TYPE	PRICE	EXTRAS AND COSTS	OPERATING EXPENSES PER DAY	LICENSING FEE	SIZE (FT.) LENGTH	WIDTH	HEIGHT	INTERIOR (Length)	INTERIOR (Height)	WEIGHT (LB.)
TRAVEL TRAILERS	$995-5,000	Jacks, step, side-view mirrors, awning, load-equalizing hitch—$110	$2.75	$25	10-29	7-8	7-8	10x6 14x7 26x8 29x6.5	6+	1,250-4,500
COACH CAMPERS	$495-1,950	Butane refrigerator, heater, folding step, unloading jacks—$200	$2.75	None	8-11½	7-8	7-9	6x6 11x7	6+	500-2,000
FOLD-OUT TENT TRAILERS	$495-1,365	Extra canvas-enclosed rooms; folding tables, butane-fired equipment—$200	$2.75	$10-20	7-14 (open)	6-8	2½-4½ (folded)	8x7 18x8	6+	400-700
MOTOR HOMES	$5,000-12,500	Heaters, electric generators, air conditioner, butane refrig., water heater, etc.—up to $2,500	High, especially on tolls	Licensed as house car, based on value	20-33	7-8	8-9	26x16 and up	6+	3,000-12,000
COMPACT BUS CAMPERS	$1,250-2,600	Camper conversion kit—$1,250	$2.75	Vehicle license only	14-15	5¾-6½	4½-5	9x8 and up	4½+	2,600-3,500
CARTOP SLEEPERS	$495-1,000	None	$2.75	None	6-14	6-7	7-8½	6x5 13x7	2	200-600

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Unusual tent camper can be toted on pickup bed or on trailer, unloaded for use at night.

WHEELS Is Best for You?

sleepers. There are variations and offshoots. One new idea is a combination coach camper and travel trailer, resembling a 10-foot-long piggyback coach with an axle and two wheels under the aft floor braces.

Another idea is a type of coach camper with pontoons. It's launched like a boat at the campsite.

Why camp? Well, it saves $10 to $20 a night in lodging, and $16 or more a day on meals.

And what about that extra gas it costs? Will it cancel the savings? The answer: For a vacation of 1,000 miles, if you got only half your normal gas mileage, it would cost you $15-$17 extra.

CAMPING VEHICLES

SLEEPING CAPACITY	FACILITIES	ADVANTAGES	DISADVANTAGES
6-8	Water tank, range, oven, dinette, kitchen, icebox, 110-V lights, closets, drawers, flush toilet, heater, water heater	Can be towed by any vehicle; trailer can be parked, locked; no packing, unpacking nightly; high resale; life expectancy 20-years plus	Reduced towing speed legally required
4-8	Water tank, butane range & oven, kitchen work area, table, drawers, bins, single closet, icebox, 12- & 110-V light systems; butane refrig. costs extra	Legal driving speeds same as car in most states. A second vehicle (boat trailer) can be towed; coach can be removed	A truck is required
2-8	Flaps, doors, windows have zippers to block drafts, insure privacy; small galley in some models; table, water supply, tank, pump; platform beds, mattresses	Low profile, low wind resistance; can be parked in home garage; low initial cost; weight is half that of travel trailer; easily unhitched from family car	Reduced towing speeds; no permanent closets or cabinets; fabric subject to tears, deterioration
2-8	Complete kitchen, bath, dining room, driving compartment, plus many drawers, cabinets, closets	Entire unit under one skin; living quarters can be occupied while driving; roomy, luxurious; most states allow passenger-car speeds	High initial cost; vehicle useless between trips; not handily parked in downtown areas; fills driveway at home; gas eater; wind-wanders at speed
5-6	Pop-up roof for extra sleeping capacity; galley, dinette, range, icebox, water supply, bunks, lighting, fold-down lower bed	Same as motor home, with less space involved. Fuel economy fine; easily parked	Restricted space
2-4	Some have stove, water supply, bunks, storage area, lights	Can be attached to any U.S. car, pickup or 4-wheel-drive vehicle; can be removed between trips; same advantages as truck camper; drive at car speeds	Side area causes wind resistance, affects overhead clearance; top-heaviness requires care in cornering; too high to park in garage

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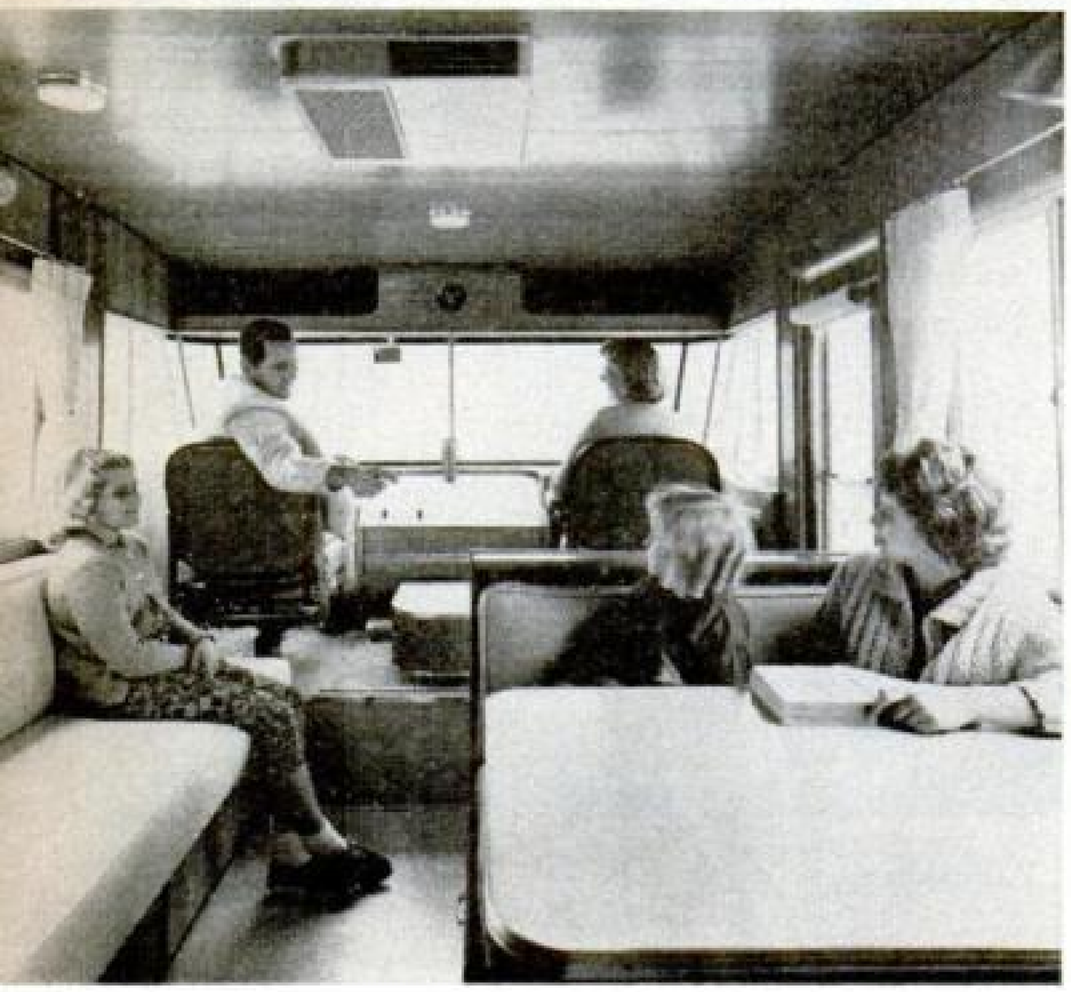
Urheberrechtlich geschütztes Material



Motor homes

The most expensive of vacation-on-wheels vehicles, typified by Condor on Ford chassis (above), incorporates most luxury (left). It has fine beds, stove, dining niche, bath, carpeting, wood-paneled walls, hot- and cold-water systems, gas furnace, and other extras. Special generator supplies current for TV. This camping equipment does have drawbacks. Most obvious one is that once it is parked for the night, there you are—you can't drive it to the nearest outdoor movie. Insurance costs, based on valuation, and license fees are high. On toll roads and bridges, the owner pays higher fees, especially if he has dual wheels. Water supply must be protected against freezing if vacationers venture into cold areas. The two biggest sellers in this field, Condor and Dodge Motor Home, weigh about five tons each.

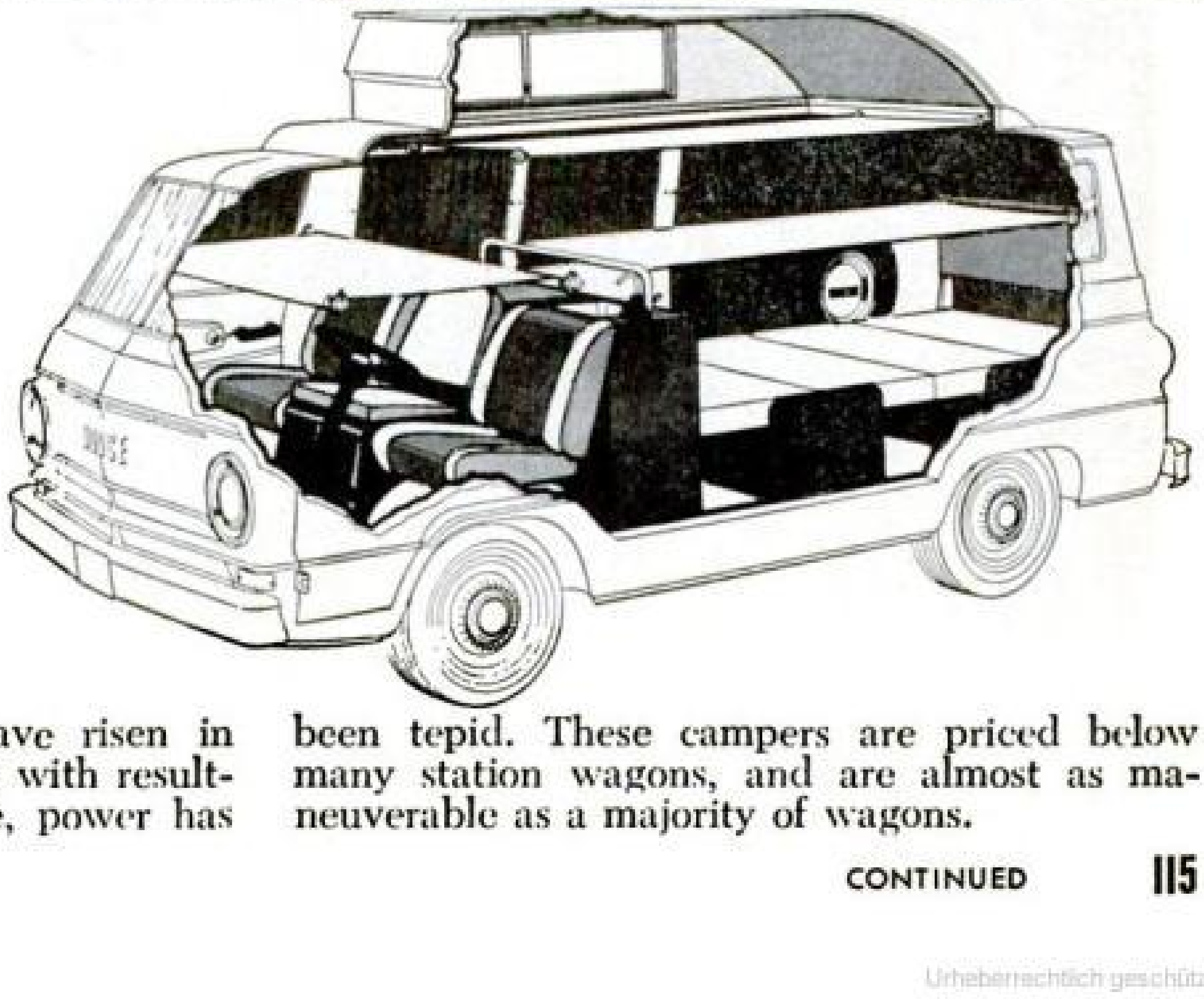
Cartop sleepers

Roof-topper (below) that collapses for travel (right) is at opposite extreme from motor home in cost. This unit does come with extras, but mostly it is used for sleeping. The idea may look a little wild, but owners speak highly of their roof-toppers. There are two main types: 1) Rigid units made of aluminum or fiberglass, and 2) folding units that pop up for sleeping as illustrated. At the campsite a telescoping lifter is used to raise and open the canvas-walled room. In the buyer's-guide table, incidentally, daily operating expenses include cost of overnight parking, ice, and butane gas. Figures do not include engine fuel and oil. A buyer of any camp-on-wheels should plan on up to 30 percent extra tire wear.

Travel trailers

Still king of camping, despite many new challengers, is the travel trailer. This 17-foot model is typical of thousands sold each year. Beyond a length of 29 feet, the trailer no longer is a vacation vehicle but a mobile home. Biggest seller is the 17-footer. Fuel consumption is about 25 percent beyond what your car normally uses. Trailers have high resale values. A unit often is worth 60 percent of its initial price after five years or more. With few parts to wear out, it has a life expectancy of 20 years and up. Jacks for stability are a must.

Bus campers



Bus camper is growing fastest in popularity—because it doubles as a family station wagon when vacation is over. Typical of breed are Volkswagen Microbus, Dodge Compact Bus, Ford Econoline, Chevy Greenbrier. Installation of bunks, stove, sink, dining table, and bubble top (cutaway at right) is extra. Converted, Dodge's job is called the Camp Wagon, sleeps up to six. Bus campers can be bought completely equipped from Detroit's regular factory-franchised dealers. Engine options have risen in 1965 models to as high as 180 hp., with resultant better performance. Heretofore, power has been tepid. These campers are priced below many station wagons, and are almost as maneuverable as a majority of wagons.

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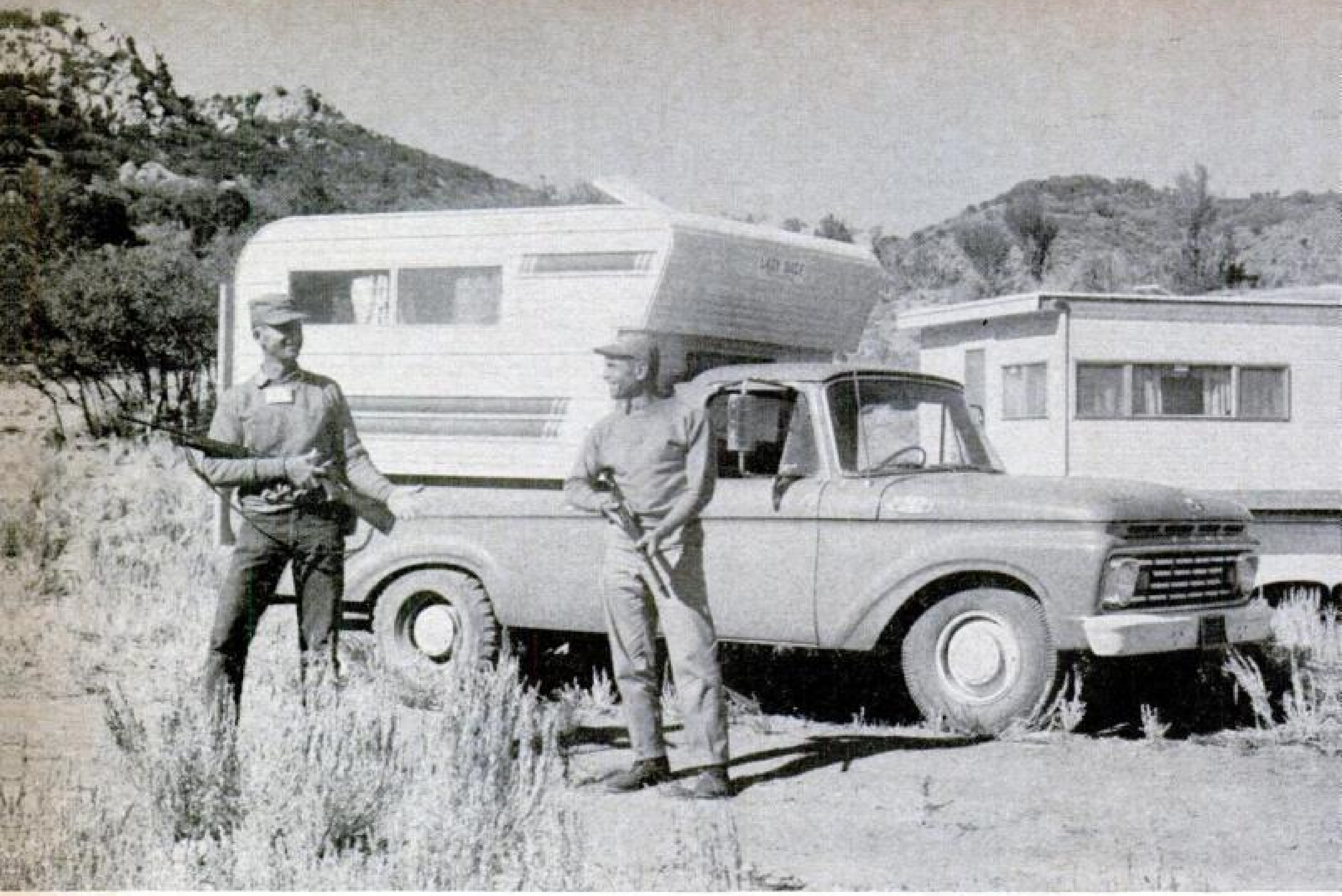
Urheberrechtlich geschütztes Material



Tent trailers

Closest to "camping" as grandfather used the term, is the tent trailer (above, with floor plan at right). With tent collapsed, the trailer tows flat, thus using a minimum of extra gas. Most popular model is the four-sleeper. Majority of tent trailers have two wheels and a tongue that attaches to car hitch. Total weight is about half that of a conventional trailer. This vehicle is still subject to rules of reduced towing speeds on highway because big and little trailers are the same to cops. This means about 10-15 m.p.h. below passenger-car speeds.

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Truck-mounted coach campers

Truck-coach camper (two pictures at left) is most versatile vehicle in equipment, ruggedness, and ability to travel in rough country. It is a favorite of hunters. Built to slide into pick-up-truck bed, it is actually a small travel trailer minus wheels and axle. Eight-foot size is most popular. Coach can be removed with special jacks, as shown, and left on blocks when truck is needed for other duties. Coach uses about 20 percent more gas.

This tent trailer expands from a length of 8 feet to 16 feet 4 inches, and provides 7 feet 10 inches of open floor area between two double beds. Dinette cushions make a third bed. It has a chemical toilet. Trailer body has double aluminum walls. Outer panels and door are gold-anodized. Under way, the collapsed tent is covered by a plastic commonly used in football helmets. It pops up to form a roof when the beds are extended. Other equipment on fancy models, made by Veseley Co., Lapeer, Mich., includes a furnace, wall-to-wall carpeting. As for fuel use of vehicles pictured in this article, average m.p.g.'s are: motor home—6-10; roof-topper—13-15; travel trailer—10-13; bus—16-21; coach—11-14; tent trailer—12-15. ■ ■

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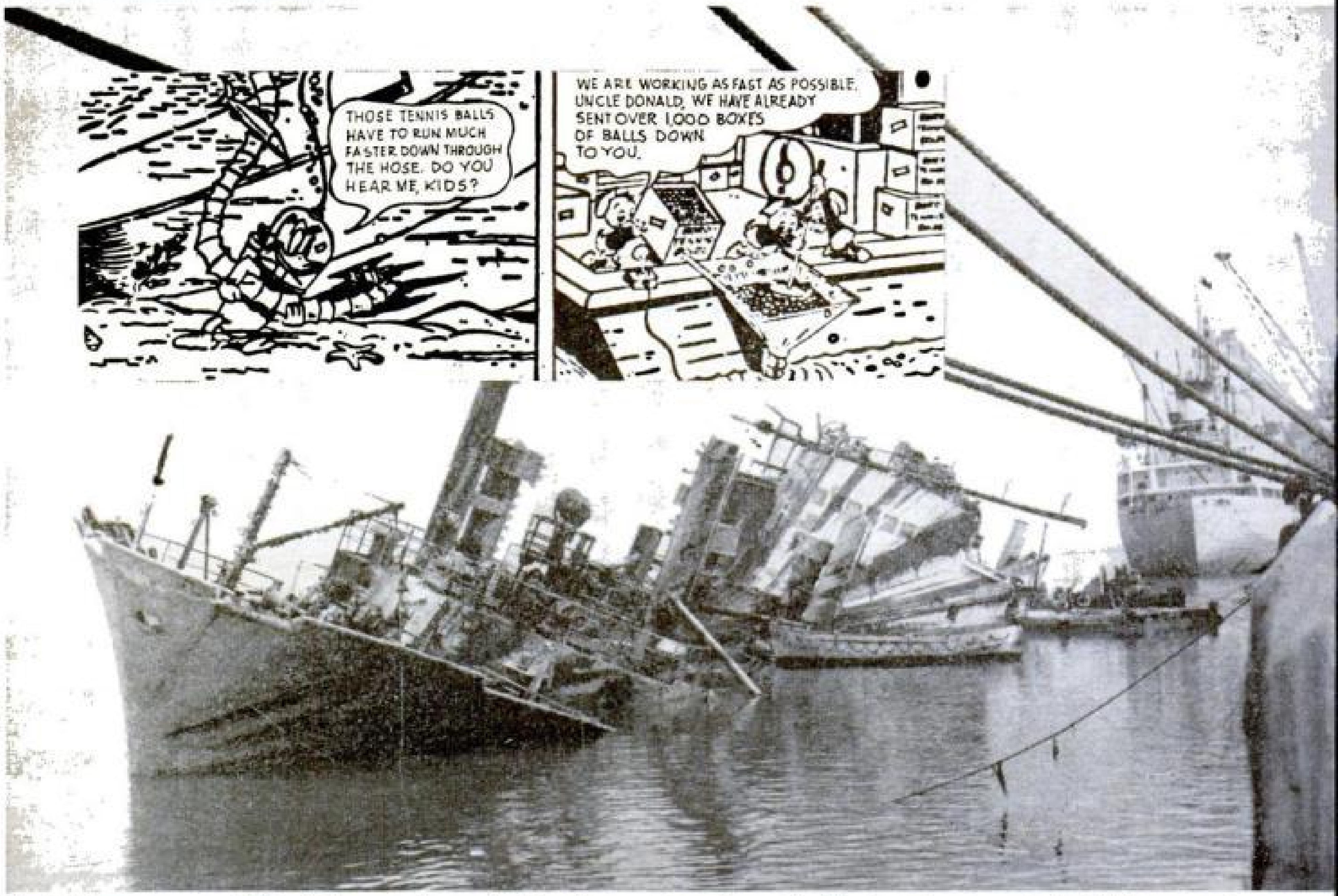


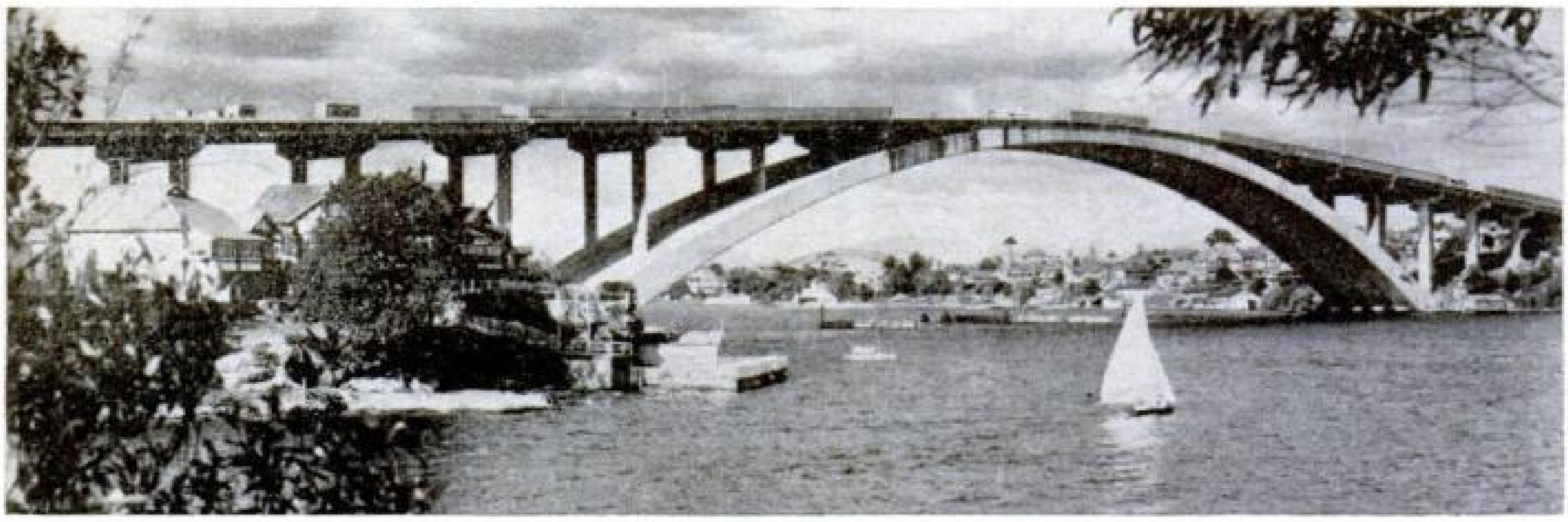
Freighter comes right-side-up along its Persian Gulf dock, as was planned. Mud marks on superstructure indicate stages of bubble-pumping. Refloating job required 150 tons of foam.

Cartoon copyright, Walt Disney Productions

Plastic bubbles help refloat capsized ship

When a freighter carrying 5,000 sheep capsized at the docks in Kuwait harbor in the Persian Gulf and threatened to contaminate a water-purification plant, an idea from a Walt Disney Donald Duck cartoon helped to raise it. Karl Kroeyer, a Danish engineer called in, remembered the cartoon in a Copenhagen newspaper.

In it Donald pumped tennis balls into the hold of a sunken ship to displace the water and give the ship enough buoyancy to float. Instead of tennis balls, Kroeyer



Bridge has longest concrete arch

Graceful Gladesville bridge over Sydney harbor in Australia measures 1,900 feet from bank to bank. It has a 1,000-foot span, world's longest of concrete, made of four parallel ribs formed by precast boxes weighing up to 50 tons. The roadway is 72 feet wide and flanked by six-foot walks. Cost of the bridge was $10,000,000.

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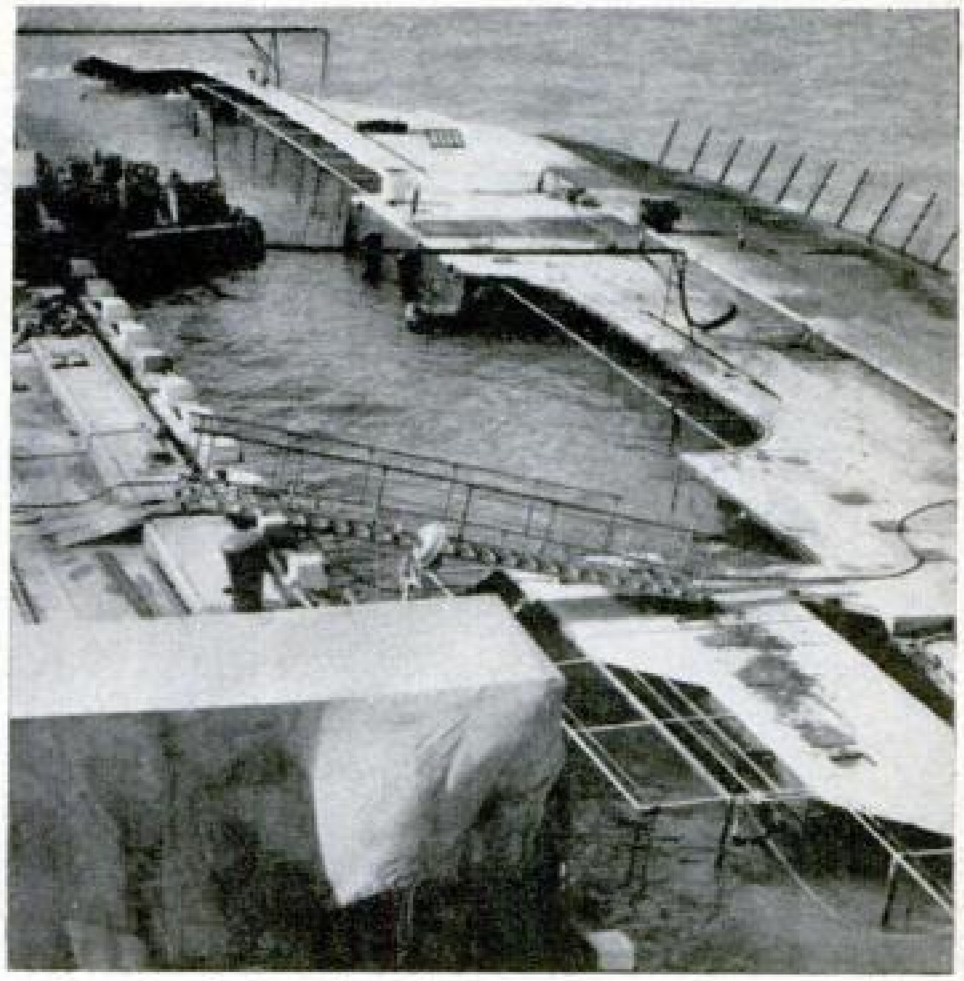
Plastic-foam bubbles are shown at connection where one hose was uncoupled for inspection.

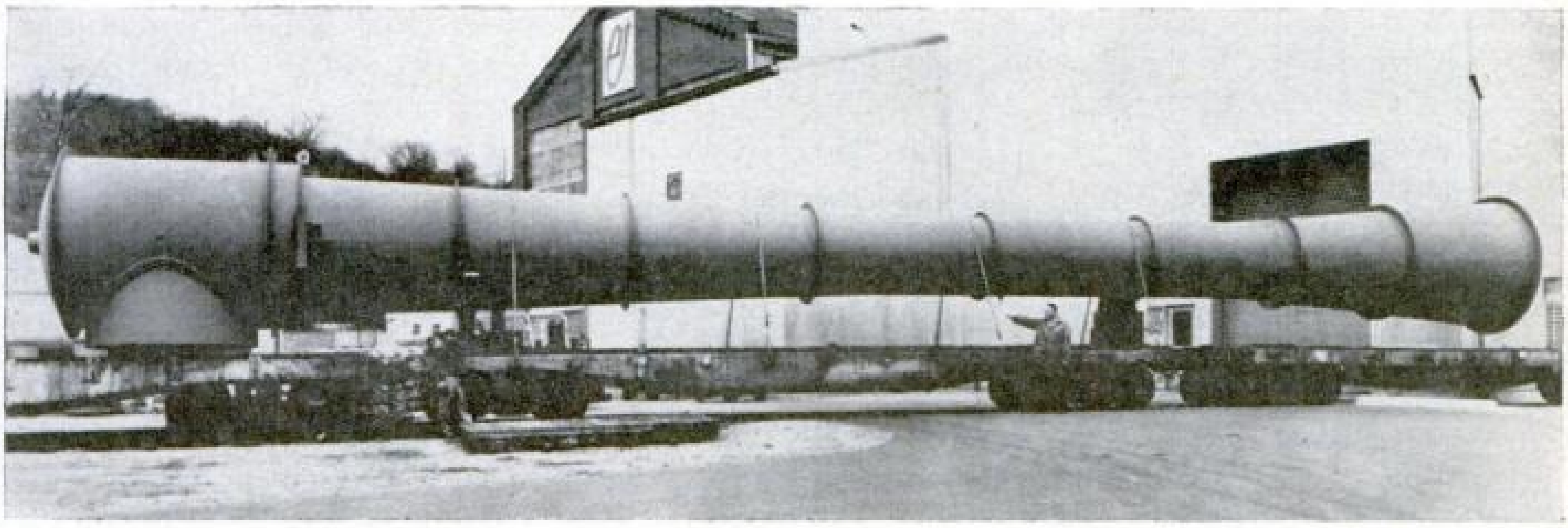
used polystyrene foam. The plastic is in crystals that heating expands to air-filled bubbles occupying 40 times the volume.

The freighter's keel was weighted and the bubbles pumped first between the two highest decks, then into lower holds. It took 150 tons of foam and three months to raise the ship and tow it safely away.



Capsized freighter lies on her side at dock in Kuwait. Sacks of polystyrene are at upper left.

Sandbags are placed on wire fencing attached at keel to counterbalance weight of superstructure.



Rocket chimney crowds three flatcars

Supported by three flatcars, this giant smokestack was transported by rail from Jeannette, Pa., near Pittsburgh, to NASA's Plum Brook Station at Sandusky, Ohio. Up-ended, the 86-foot-long ejector will be used to disperse exhaust gases produced by research rocket engines fired in a large high-altitude-simulation chamber.

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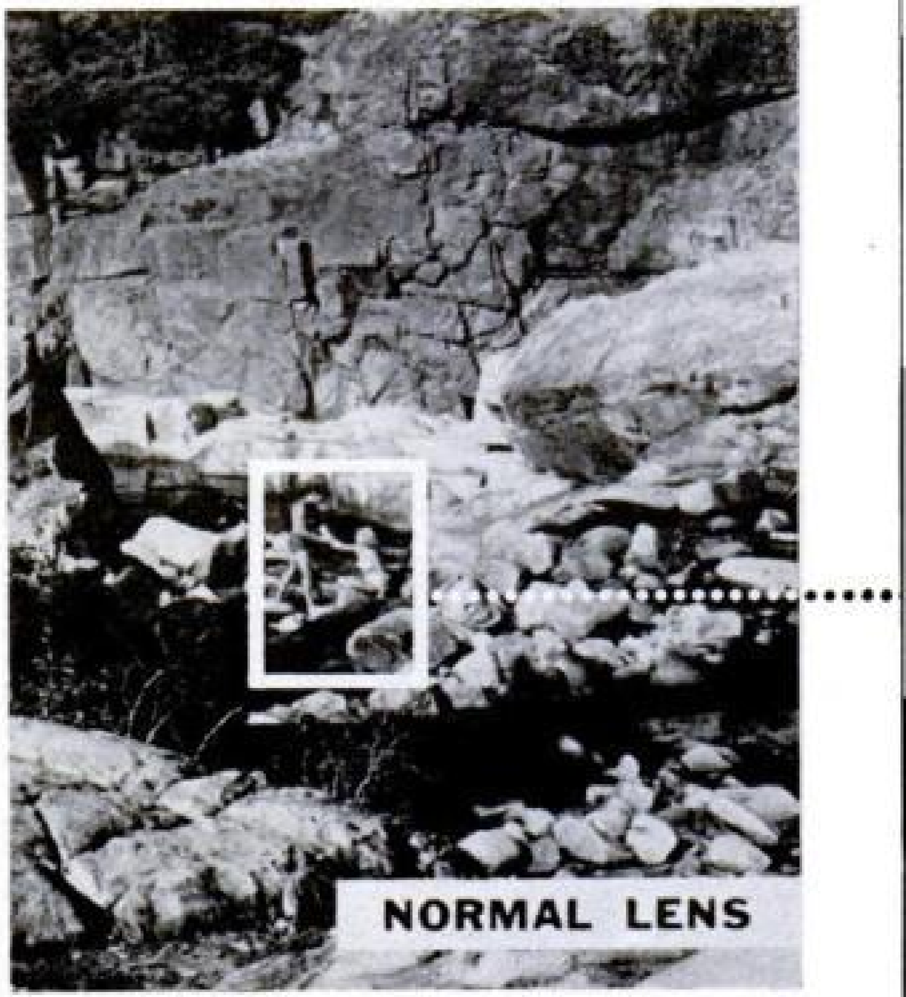
Way to
Telephoto



Big scene, little people—okay if you like rocks and streams. But suppose you are shooting from edge of gorge and want to bring the people close up?

Take a look at the new lenses and tele systems. Prices: amazingly low. Quality: amazingly high

By Paul Wahl

DOES your 35mm make molehills out of mountains? Does that girl in the bikini escape your camera because your lens won't reach out for her without also taking in half the beach?

These frustrations occur not only with a 50mm normal lens, but even with medium-longs such as the 135, which gives a 2.7 times bigger image. For distant subjects, what you need is a 200mm or longer lens. A hundred feet from your subject, that 4X magnification of the 200mm gives you the same size image as you'd get with a 50mm 25 feet from the subject.

It used to be said—accurately—that a good telephoto lens cost about a dollar for every millimeter of focal length. No wonder the average photographer decided to make do with a 135mm. How do you justify spending two or three hundred bucks for a lens you'll use only rarely?

Now, the "dollar-a-millimeter" rule has been broken. If your 35mm is a focal-plane-shutter single-lens reflex, you can equip it for telephotography at comparatively low cost with one of the new, modestly priced lenses, tele-converters, or monoculars.

Telephoto lenses. Since one telephoto lens can cost several times as much as another of the same focal length, you might conclude that one is greatly inferior, or the other grossly overpriced. Generally, neither is so. Most lower-priced telephotos are acceptably good in overall quality and performance, while higher-priced lenses usually are worth their cost.

What do you get for the extra money? Manufacturers of the more expensive lenses can afford to use the best optical glass, mount the lens elements with greater care and precision, and furnish a more substantial mount made to closer tolerances. Moving parts work more smoothly, and the fit of the mount to the camera body is likely to be better. To those who can afford the best, these things justify the higher price.

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Close-ups from a distance are easy with a long-focal-length lens. Picture at left was shot from the same position as the one on the facing page. But instead of a normal 55mm lens, the photographer used a 500-mm Takumar telephoto. He could have taken much the same picture (with a slight loss in sharpness) with either converters on his normal lens or a photo-monocular.

But often, the difference in quality between pictures taken with cheap and expensive tele lenses is not readily apparent to any but the most critical viewers. So it pays to take a look at the low-to-medium-price lenses. You'll find a wide choice of good tele lenses tagged from about $30 up. Some brands especially worth looking at: Komura, Soligor, Spiratone, Vivitar.

To the average photographer, the more useful long telephoto lenses are in the 200-to-400mm range. A 300mm, the longest lense you can hand-hold in a normal manner, is a good compromise.

Tele-converters. The hottest thing in accessories today for your 35mm single-lens reflex is a gadget that stretches focal length. Backed up by a 3X tele-converter, a 50mm lens becomes a 150mm, a 135mm is boosted to 405mm. Available in 1.5X, 1.85X, 2X, and 3X models (the latter two are more popular), with mounts to fit most SLRs, these converters range in price from about $15 to $35.

A tele-converter (also called "expander" or "extender") is a minus lens, usually two-element, in a short extension tube that fits between camera and lens. It magnifies an image formed by the lens without affecting the minimum focusing distance. Effective aperture, however, is reduced.

To find the effective focal length and aperture of a lens-and-converter combination, you simply multiply the lens' focal length and aperture by the magnification of the converter. A 135mm f/2.8 lens with a 2X tele-converter, for example, becomes a 270mm f/5.6. If the lens alone focuses down to six feet, it will still focus to six feet with the converter—but the image will be twice as large.

To get higher magnifications, you use two converters behind the lens: two 2X yield 4X; 2X plus 3X, 6X; two 3X, 9X.

A typical 2X converter adds about an inch to the length of the lens, and less than four ounces to its weight. It takes only seconds to install or remove one.

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The big picture is fine—if you're not looking for architectural details. This one was taken with a 50mm normal lens.

Don't make a move—just increase your focal length to 135-mm and you get this picture of clock tower and turret.

For fine detail, without moving from your shooting spot, switch to a 250mm. Result: the beauty of lacy ironwork.

Changing the focal length lets you snap any part of the scene you want

For use with automatic lenses, there are now tele-converters with couplings to maintain automatic diaphragm control. Sounds great, doesn't it? Unfortunately, there are drawbacks.

A converter creates the effect of longer focal length by magnifying the image produced by the lens it's extending. But at the same time it magnifies any faults in that lens. Even with the best lens capable of critically sharp results when used alone, a tele-converter will cause some image deterioration. Sharpness loss will be slight but noticeable at center of the picture, more pronounced at the edge. Generally, you'll get better images with lower-powered converters; and, needless to say, one converter will degrade the image less than two.

Used with a superior long-focus lens, a good tele-converter can produce remarkable results, although not on a par with those you'd get with a high-quality lens of the same focal length alone. You'll get better pictures with a good 400mm lens than with a 200mm plus 2X converter or a 135mm plus 3X. Using a mediocre lens with a tele-converter may result in barely passable picture quality.

Converters seem to be at their best with 200mm and longer lenses—though you may get by with a 135mm. With shorter focal lengths, the light rays enter the converter at such an acute angle that center, as well as edge, sharpness is adversely affected. You might use a tele-converter with a normal lens for portraits, where softness often is desirable; but results in long-range work probably will be disappointing. Since zoom lenses usually are somewhat poorer in definition than lenses with a single focal length, their use with converters generally is not advisable.

Effective lens aperture is affected by a converter in proportion to its magnification, and compensation must be made in exposure. Having to calculate effective *f* stops while shooting is a nuisance and can lead to confusion and errors. To avoid this, you can compensate by adjusting the film-speed rating—divide the ASA exposure index by 4 for a 2X converter, by 9 for 3X.

I have used TelXtenders (Spiratone), as well as the Soligor (Allied Impex) and Vivitar (Ponder & Best) converters; all three makes performed satisfactorily. Other converters may be as good, but quality varies and only trial will tell.

Photo-monoculars. A monocular is half a binocular—actually, a short prismatic telescope of low power. Mounted on a focal-plane-shutter SLR instead of the usual lens, it becomes a projection telephoto system.

Here's how it works: The image formed by the objective lens of the monocular is projected by its eyepiece through a connecting tube of variable length onto the film in the camera. By increasing the length of the tube, you enlarge the projected image, thus getting the effect of longer focal length. As focal length is increased, effective aperture decreases. No iris diaphragm is incorporated, but

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Three different ways to bring the scene up close

TELEPHOTO LENS

Take your choice: Any of these three systems, all comparable in focal length, will deliver a first-class telephoto picture. Top: Soligor 450mm telephoto lens. Center: Takumar 200-mm tele lens with 2X Tel-Xtender (400mm). Bottom: Bushnell TeleVar photo-monocular with variable (350-650mm) focal length.

aperture disks are available, as accessories, to stop down the lens for greater depth of field. You focus by turning a large ring around the objective lens.

A monocular is not a zoom lens. Focal length is variable, as in a zoom lens, but the monocular must be refocused for each change in equivalent focal length; a zoom lens remains in focus as focal length is changed.

The first successful varifocal photo-monocular was Bushnell's TeleVar. Still widely popular, it is light (19 ounces) and compact (7¼ inches), easy to carry, and usually can be hand-held successfully. Its range of focal lengths—350mm to 650mm—will take care of most long-range picture-taking situations. It's priced at about $60.

The Glanz Zoomatel, a similar photo-monocular system, covers the same 350mm-to-650mm range as the TeleVar and, with the addition of a short tube furnished with its Teleshot variable-focal-length adapter, goes from 700mm f/17 to 1,000mm f/25. Available with adapters to fit most popular single-lens reflexes, the Zoomatel lens system—7X40 monocular and Teleshot adapter—sells for about $100.

For extreme telephotography, a field formerly restricted to the Big Bertha class of tele lenses, Bushnell offers their Spacemaster 750mm-3,000mm telephoto system ($110). The basic Spacemaster unit is a high-grade 60mm prismatic telescope with a 15X eyepiece. A variable mount, similar to that of the TeleVar monocular, attaches it to any single-lens-reflex camera with removable lens. With 15X eyepiece, equivalent focal length and aperture range run from 750mm at f/12.7 to 1,500mm at f/25. With accessory eyepieces ($22.50), you can extend this range way up to 3,000mm.

How good are the photo-monoculars? Although not as sharp, especially at the edges, as pictures you'd get with a good telephoto lens of the same focal length, the results will more than please most photographers. At a cost of less than 10 cents per millimeter of focal length, photo-monoculars are real buys. What other 650mm lens is a pocketable 7¼ inches long? ■ ■

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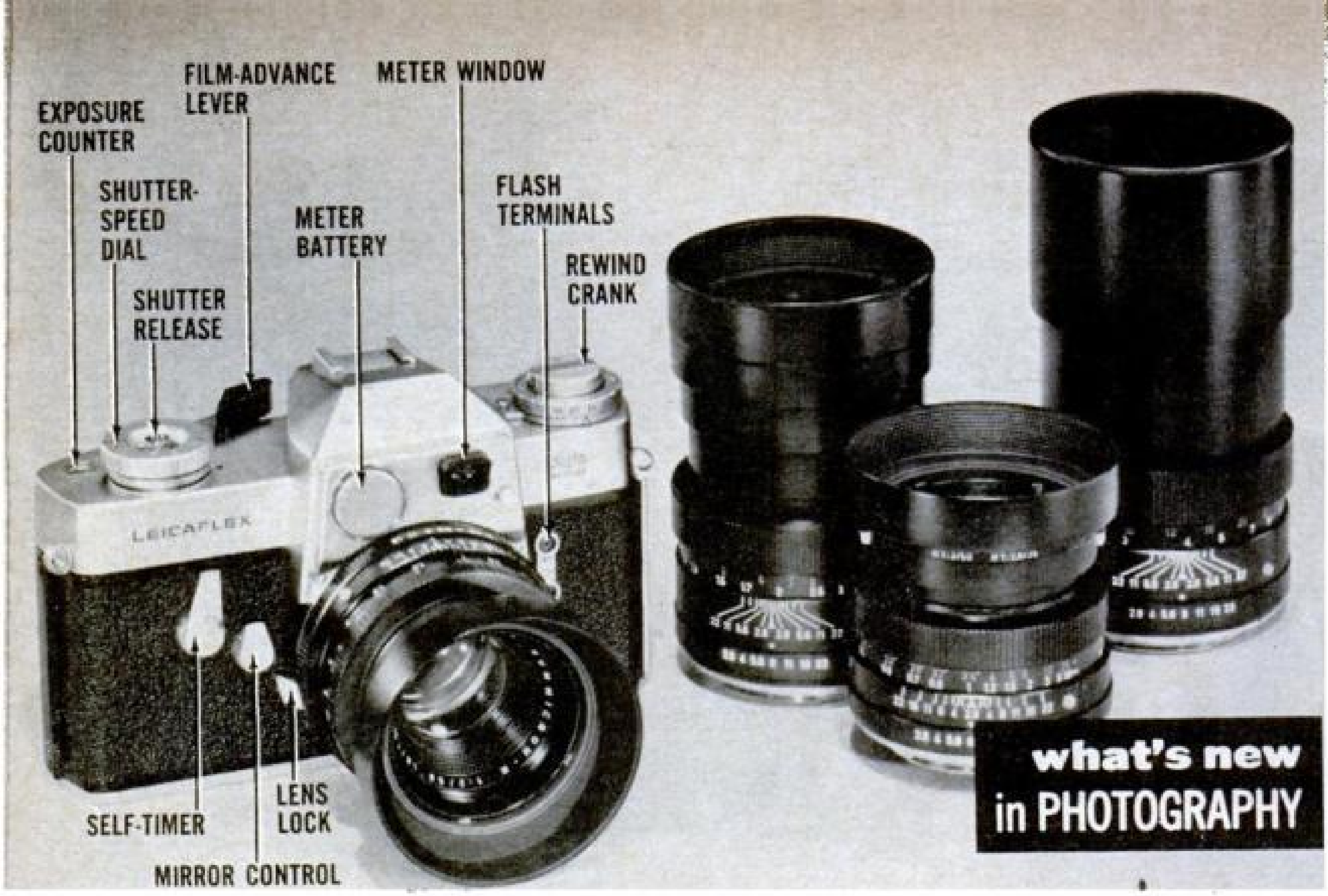


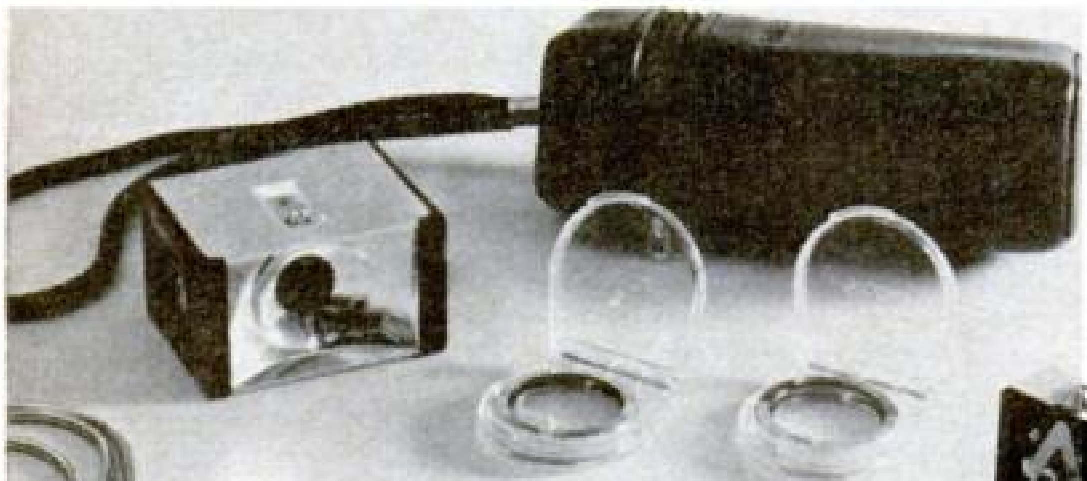
At long last, Leica offers an SLR

AFTER years of rumors and impatient waiting by camera fans, the Leicaflex finally has been unveiled.

It is not, as some people may have expected, of a revolutionary design. Rather, Leitz engineers chose to follow the standard single-lens-reflex pattern, incorporating—in refined form—all of the well-proved features usually considered desirable, if not essential: focal-plane shutter, pentaprism viewfinder, instant-return mirror, automatic diaphragm control, complete interchangeability of the lenses, and built-in, coupled exposure meter.

The big difference between the Leicaflex and other SLRs with similar features is spelled out in the first five letters of the name: L-e-i-c-a. For more than 40 years, 35mm cameras bearing this name have been characterized by incomparably high quality and reliability. The new reflex obviously has inherited these family traits.

You can own a Leicaflex with a 50mm Summicron-R f/2 lens for $585. E. Leitz, 468 Park Ave. S., NYC.



New Rollei 16 automatic is vest-pocket size

The famous family of Rolleis has a new member. For the first time, Rollei departs from the twin-lens design that they pioneered. The Rollei 16 is equipped with a single f/2.8 Zeiss Tessar 25mm lens. A collapsible viewfinder is pulled out from one end to uncover the lens for shooting. Lens aperture and shutter speed are automatically controlled by a built-in exposure meter. It uses 18-exposure rolls of 16mm film. $189.50.

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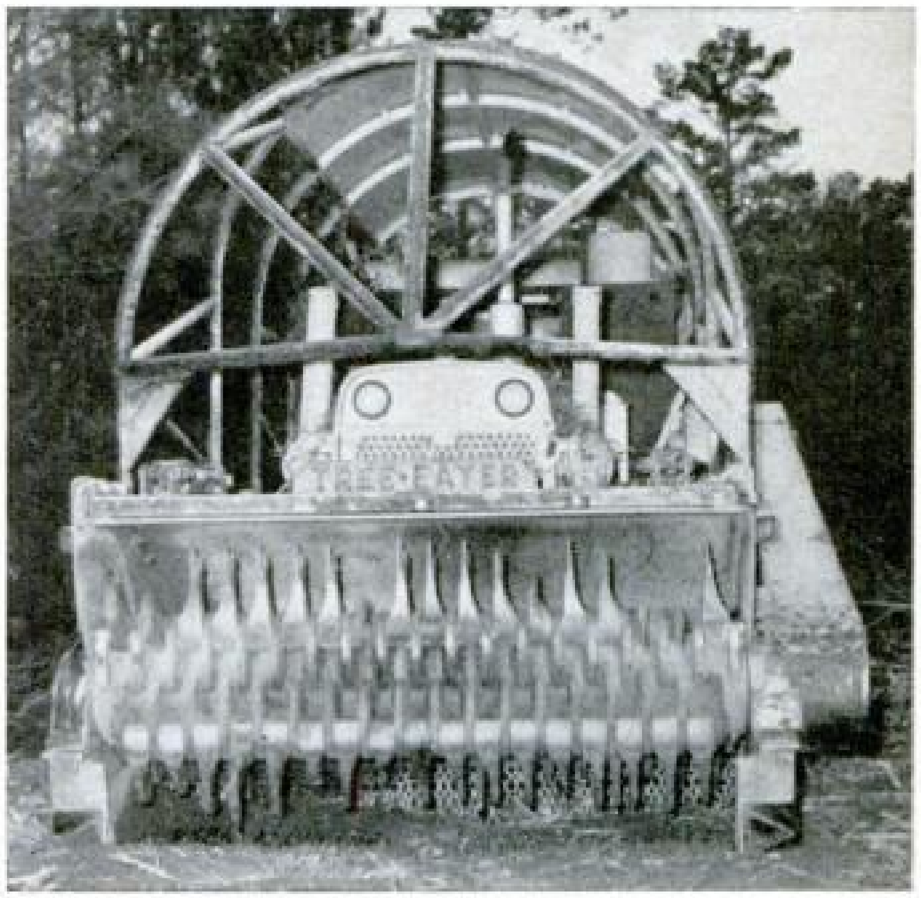
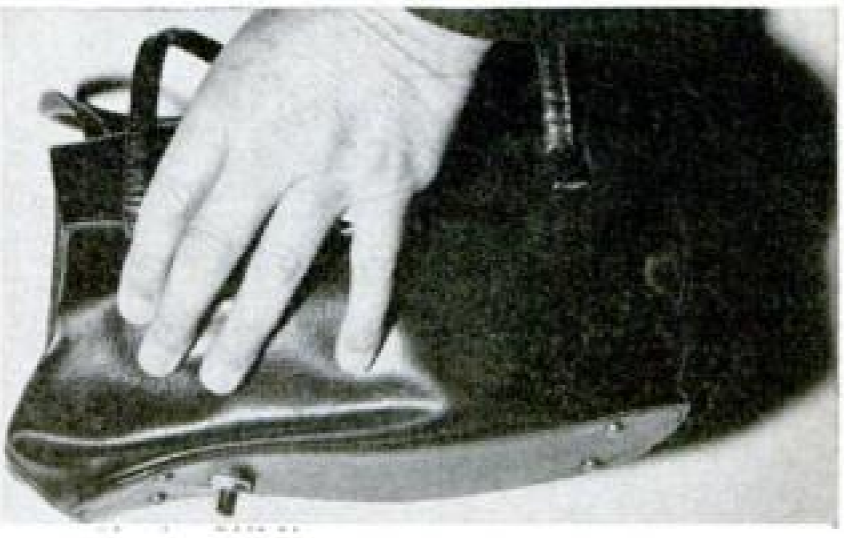
Tree-Eater makes land clearing one-man operation

A 24,000-pound mechanical termite not only cuts down trees at ground level, but chews them to splinters as it chomps its way through forests and underbrush.

Developed by C. B. Foshee of Gurdon, Ark., the Tree-Eater, with one man in the driver's seat, gobbles a six-foot-wide swath in one pass, traveling up to 10 m.p.h., and removing trees and stumps up to eight inches in diameter. It works so thoroughly a car can follow in its tracks. It can clear up to an acre an hour.

Mounted on tractor and driven by diesel, drum whirls four rows of 10-inch teeth through trees and brush. It leaves land ready for planting.





Church sets trap for purse snatchers

Annoyed by thieves who steal purses from women praying in church, a San Francisco pastor rigged up this decoy bag. When it is lifted from a pew, a battery-operated bell sounds off. A switch on the bottom of the bag is the type that lights a bulb inside a car when the door is opened.

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Build This 3-WAY BOAT for Less Than $50

—sail it —paddle it —power it

By George Daniels

HERE'S 15 feet of novel watercraft that's all fun and thrills. You can build it for less than $50. In fact, depending on how much you want, it may cost you even less.

The hull only, for paddling, fishing, and general loafing, can be had for under $25. It's just two sheets of ¼" plywood cleverly cut and framed to make a strong, light double-ender that combines the handling ease of a canoe with the stability of a flat-bottom rowboat. Add a canoe-type bracket for a

Here's your FREE BLUEPRINT ▸

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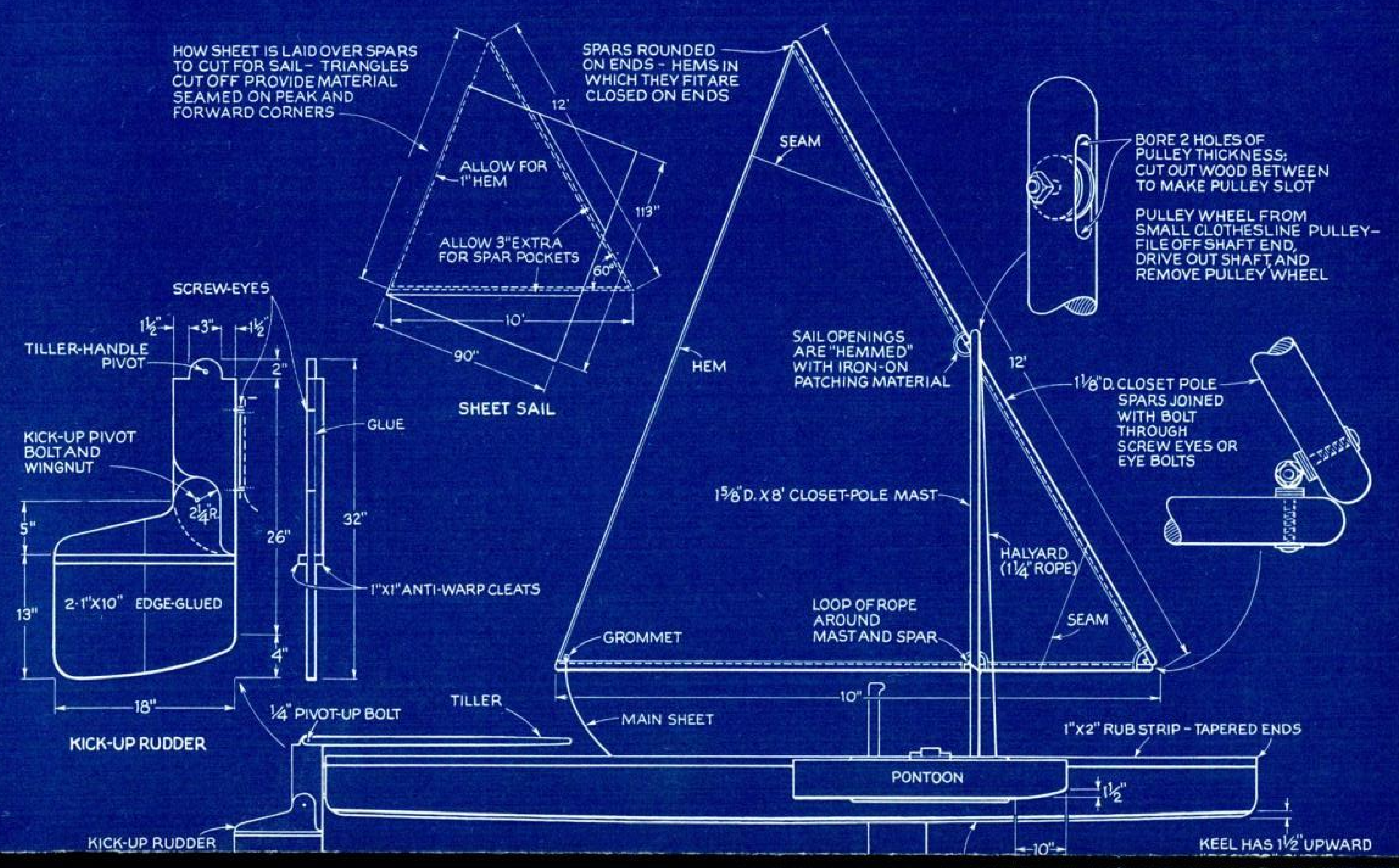
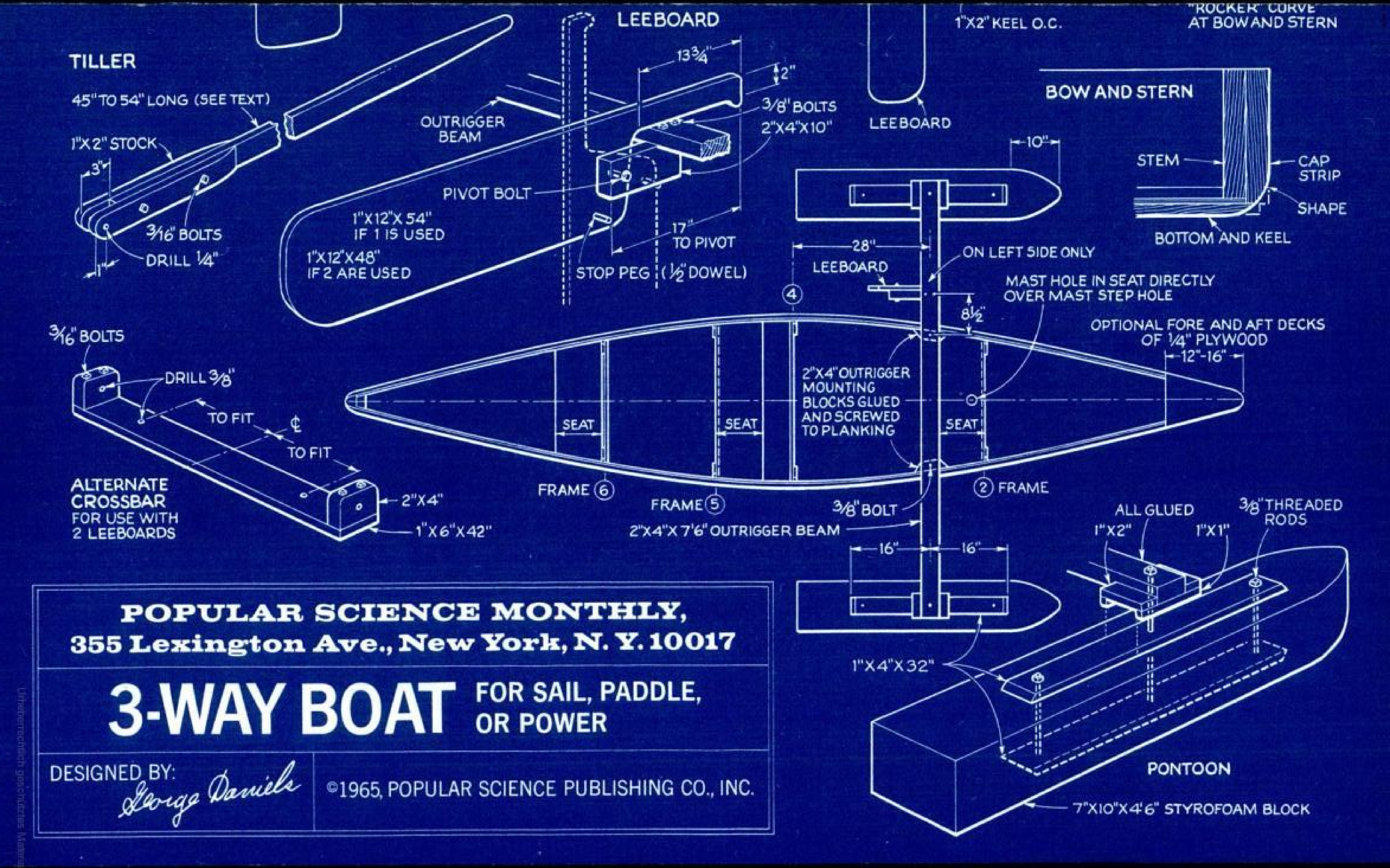

HOW SHEET IS LAID OVER SPARS TO CUT FOR SAIL - TRIANGLES CUT OFF PROVIDE MATERIAL SEAMED ON PEAK AND FORWARD CORNERS
12'
ALLOW FOR 1" HEM
113"
ALLOW 3" EXTRA FOR SPAR POCKETS
60"
10'
90"
SHEET SAIL
SPARS ROUNDED ON ENDS - HEMS IN WHICH THEY FIT ARE CLOSED ON ENDS
SEAM
HEM
SAIL OPENINGS ARE "HEMMED" WITH IRON-ON PATCHING MATERIAL
BORE 2 HOLES OF PULLEY THICKNESS; CUT OUT WOOD BETWEEN TO MAKE PULLEY SLOT
PULLEY WHEEL FROM SMALL CLOTHESLINE PULLEY- FILE OFF SHAFT END, DRIVE OUT SHAFT, AND REMOVE PULLEY WHEEL
12'
1 1/8" D. CLOSET POLE SPARS JOINED WITH BOLT THROUGH SCREW EYES OR EYE BOLTS
1 5/8" D. X 8' CLOSET-POLE MAST
HALYARD (1 1/4" ROPE)
SEAM
LOOP OF ROPE AROUND MAST AND SPAR
GROMMET
10"
MAIN SHEET
TILLER
1"X2" RUB STRIP - TAPERED ENDS
PONTOON
1 1/2"
KEEL HAS 1 1/2" UPWARD
10"
SCREW-EYES
1 1/2"
3"
1 1/2"
TILLER-HANDLE PIVOT
2"
GLUE
KICK-UP PIVOT BOLT AND WINGNUT
2 1/4" R
26"
32"
5"
1"X1" ANTI-WARP CLEATS
2-1"X10" EDGE-GLUED
13"
4"
18"
1/4" PIVOT-UP BOLT
KICK-UP RUDDER
KICK-UP RUDDER



POPULAR SCIENCE MONTHLY,
355 Lexington Ave., New York, N. Y. 10017

3-WAY BOAT FOR SAIL, PADDLE, OR POWER

DESIGNED BY: George Daniels

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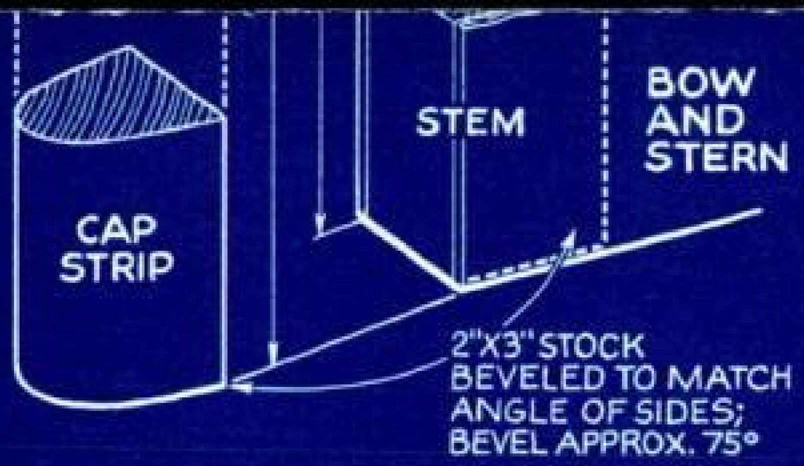
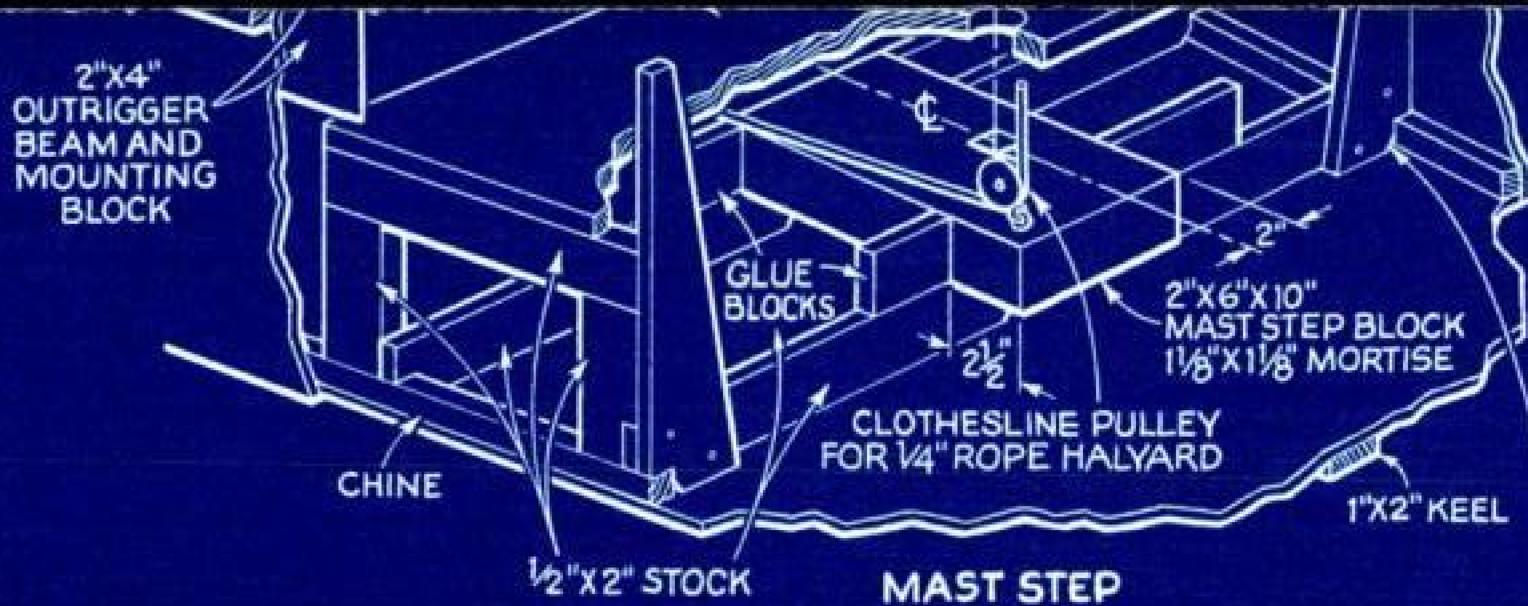
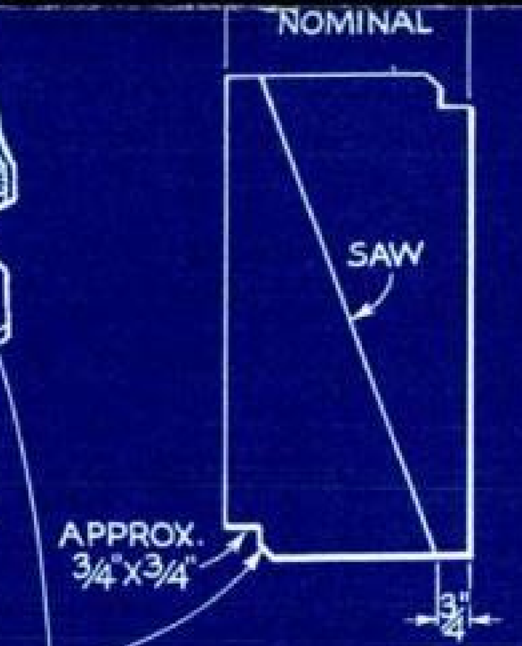
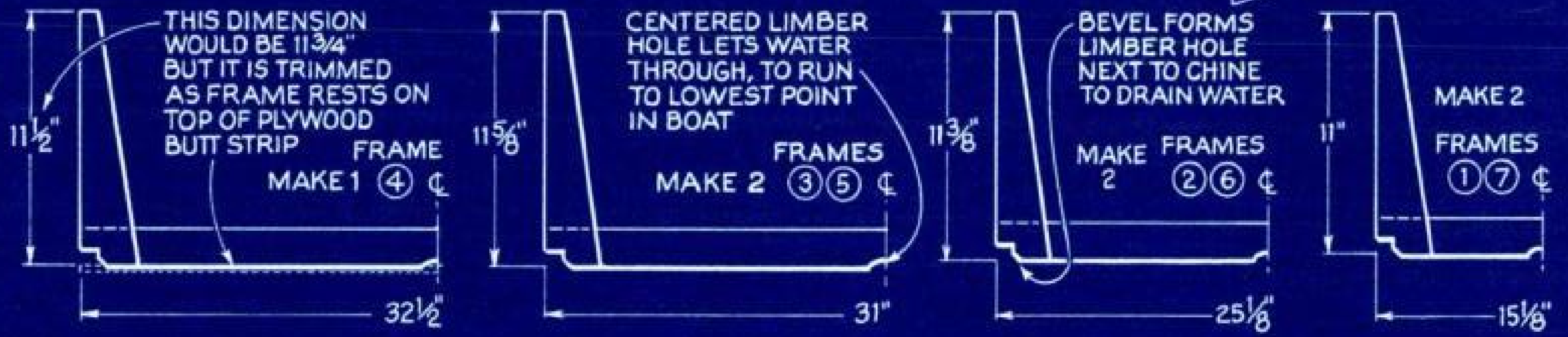


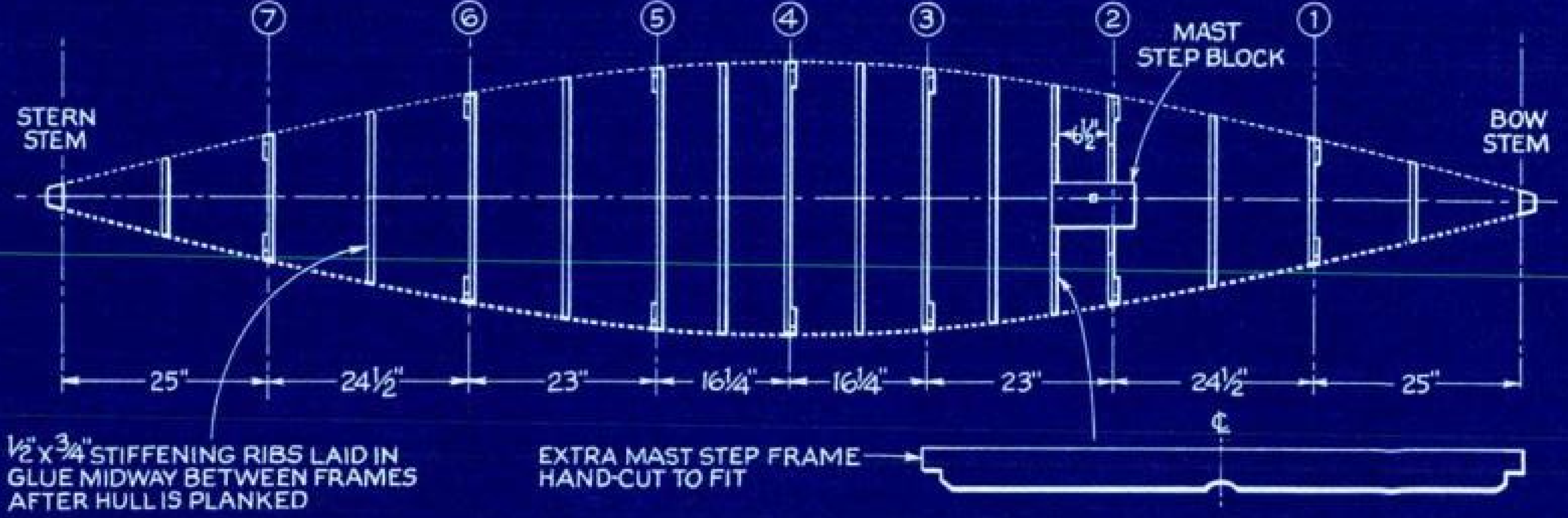


MAST STEP





FRAMES



List of Materials

FOR HULL ONLY

2–4′ x 8′ panels ¼″ exterior plywood for bottom and sides
4′–½″ x 6″ pine for side frames
24′–½″ x 2″ pine for bottom frames and stiffening ribs
8′–1″ x 10″ pine for seats
70′–1″ x 2″ for chines, rub rails, keel
4′–2″ x 3″ fir for stems
1–2′ x 4′ panel ¼″ plywood for decks (optional)
1–qt. resorcinol waterproof glue
Small headless brads for temporary fastening (copper nails optional)

FOR SAIL RIG

8′–1⅝″ closet pole for mast
22′–1⅛″ closet pole for spars
1–90″ x 113″ (or nearest available size) double bed sheet for sail
10″–2″ x 6″ fir for mast step block
9′–2″ x 4″ fir for outrigger crossbar and gunwale blocks
12′–1″ x 4″ pine for pontoon mounts
6′–1″ x 10″ pine for rudder
5′–1″ x 12″ pine for leeboard
8′–1″ x 2″ for tiller bar and mounting cleats
9′–7″ x 10″ Styrofoam block for pontoons
6′–⅜″ threaded rod for pontoon mounts
¼″ and ⅜″ mounting bolts, small clothesline pulleys, ¼″ rope, cleats, other boat hardware as desired

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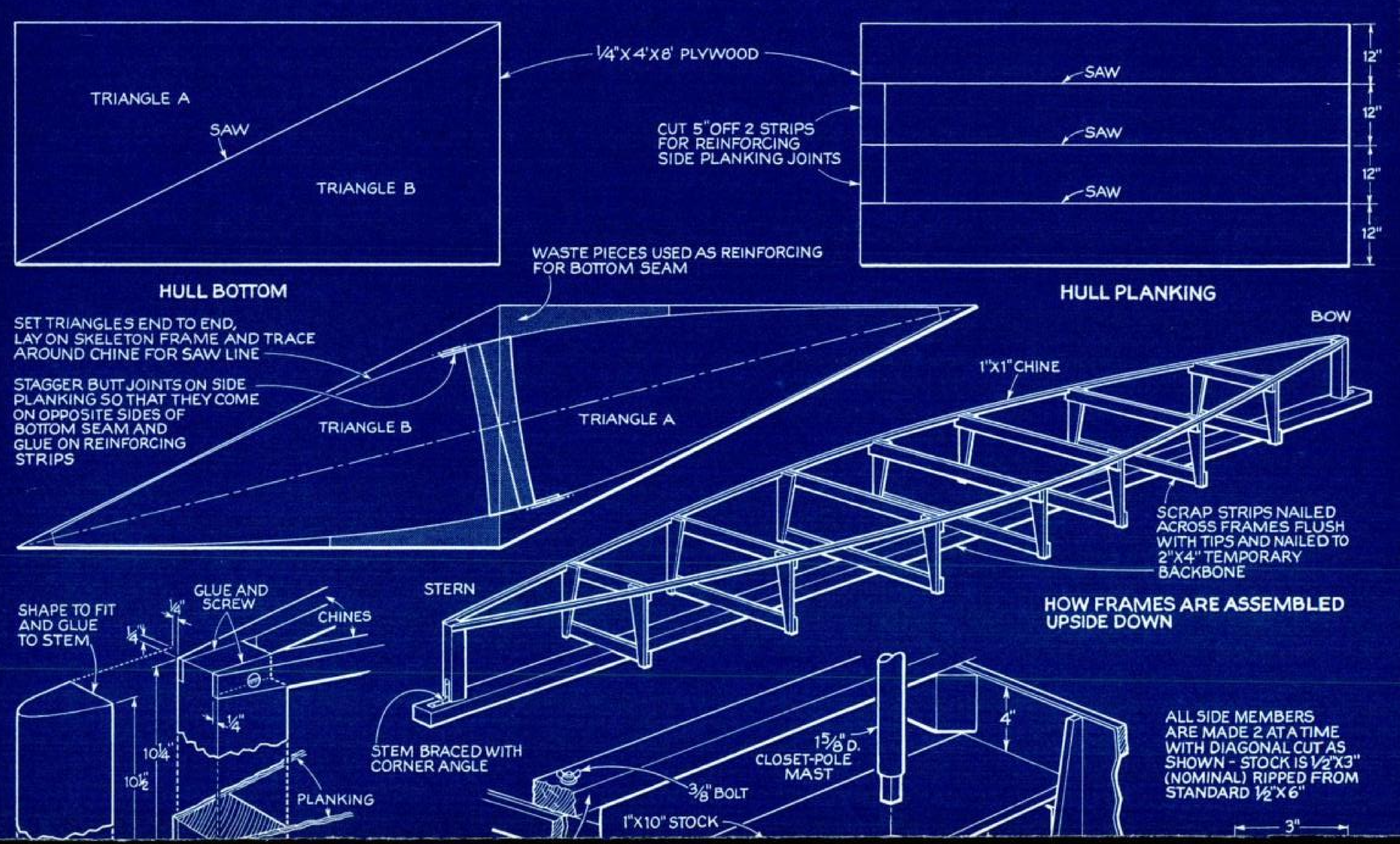

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Without the sail, the double-ender becomes a lightweight, canoe-like craft for paddling. It handles with the ease of a canoe, but is less tippy because the flat bottom resists rolling.

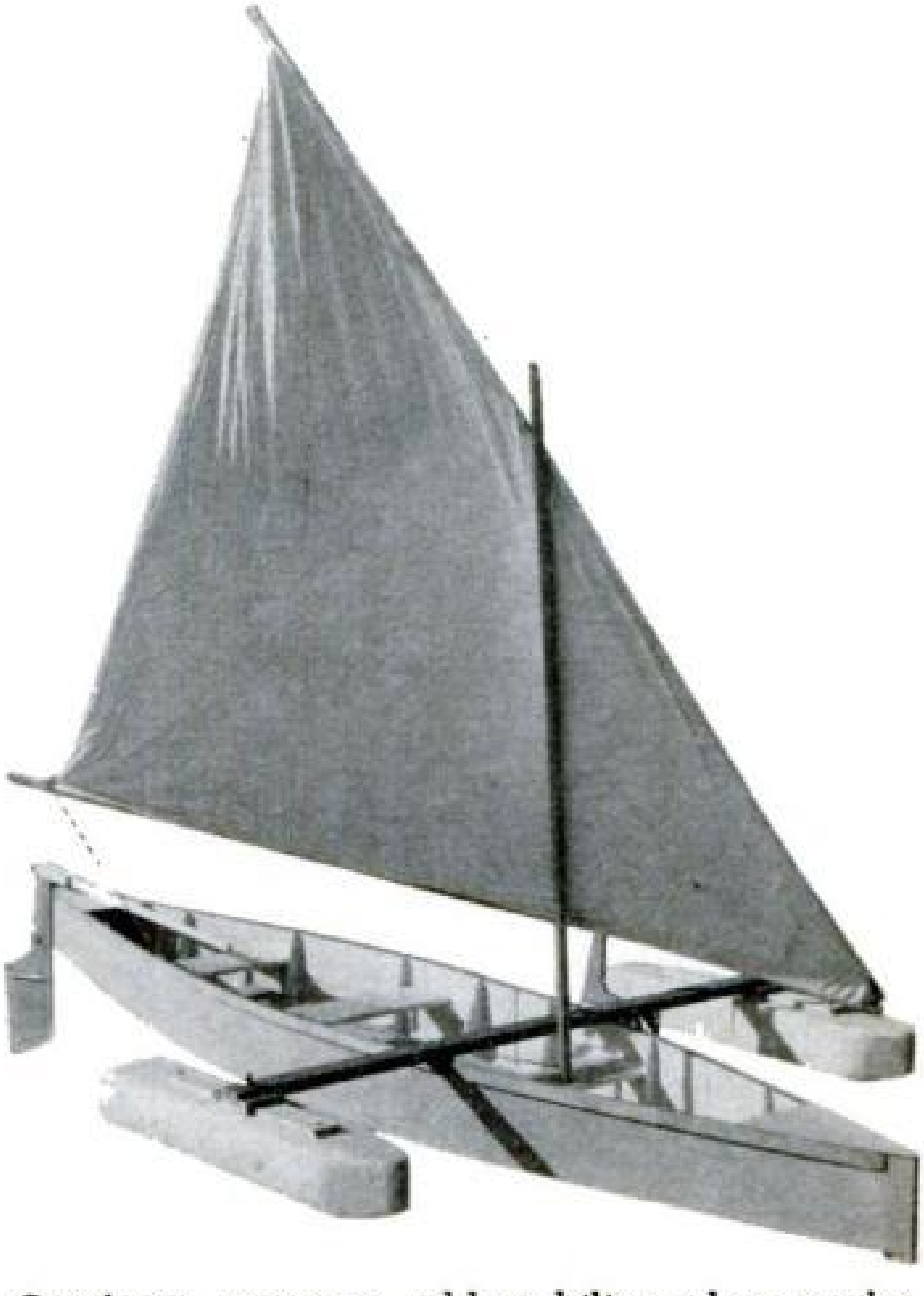
small outboard and you have a power boat that will cruise all day on a couple of quarts of fuel.

For another $13 or $14, you can turn the boat into a breezy little sailer. Finally, there's a pair of outrigger pontoons that add another $10, bringing the total to about $48—still under $50.

The pontoons, made of Styrofoam blocks, are optional. They aren't needed for safe sailing, but they give you tip-proof insurance in rough waters or when youngsters are aboard. They also turn the boat into a stable platform for offshore swimming and skin diving. If you like your sailing wild and racy, omit the pontoons. This will reduce drag and permit the boat to heel better in a hard blow.

Special tricks make it possible. If you're wondering how you get so much boat for so little money, the secret lies in some clever dodges in construction. The 15′ hull bottom is made from a single sheet of ¼″ plywood by sawing the sheet in two diagonally. Laid base-to-base, the two triangular halves form a diamond more than twice the length of the original panel. If the sheet were cut down the middle, there wouldn't be enough width for the hull, but the diagonal trick provides both the needed width at the hull's midpoint and the required overall length.

Other tricks cut the cost, too. The sail is a bed sheet. The mast and spars are ordinary closet-pole stock. The plywood hull is framed with cheap, light ½″ pine stock ripped diagonally so you get two ribs



Outrigger pontoons add stability when you're under sail, but can be removed quickly. To minimize drag, they're designed to ride out of the water until the boat starts to tip.

from each piece. The ½″ stock is a ½″-by-6″ ripped to two ½″-by-3″ strips to save the waste of trimming ½″-by-4″ stock.

Oddly enough, the very things that are done to save expense help to produce advantages. What you get is a tough, lightweight, stressed-skin construction that's easy

CONTINUED

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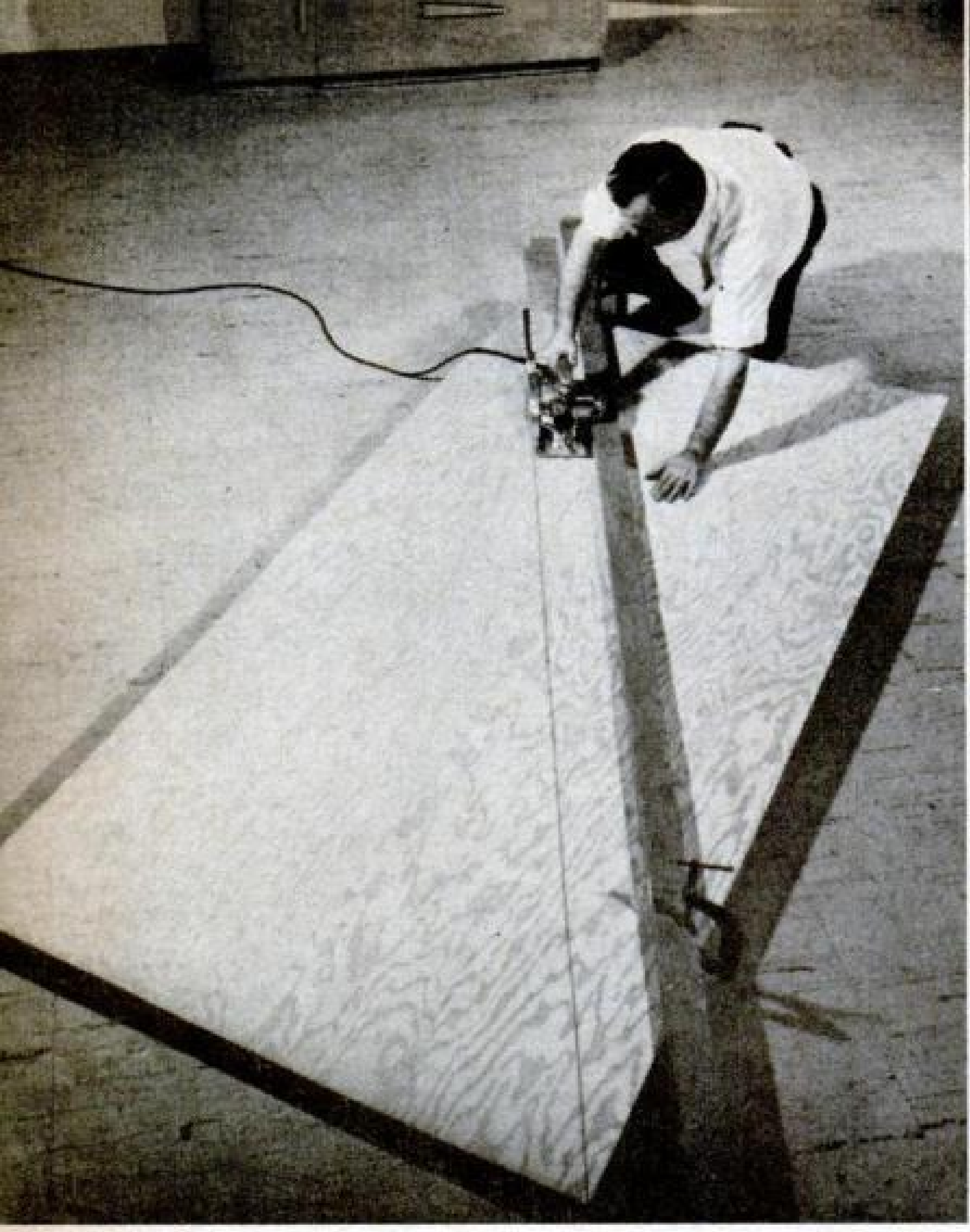
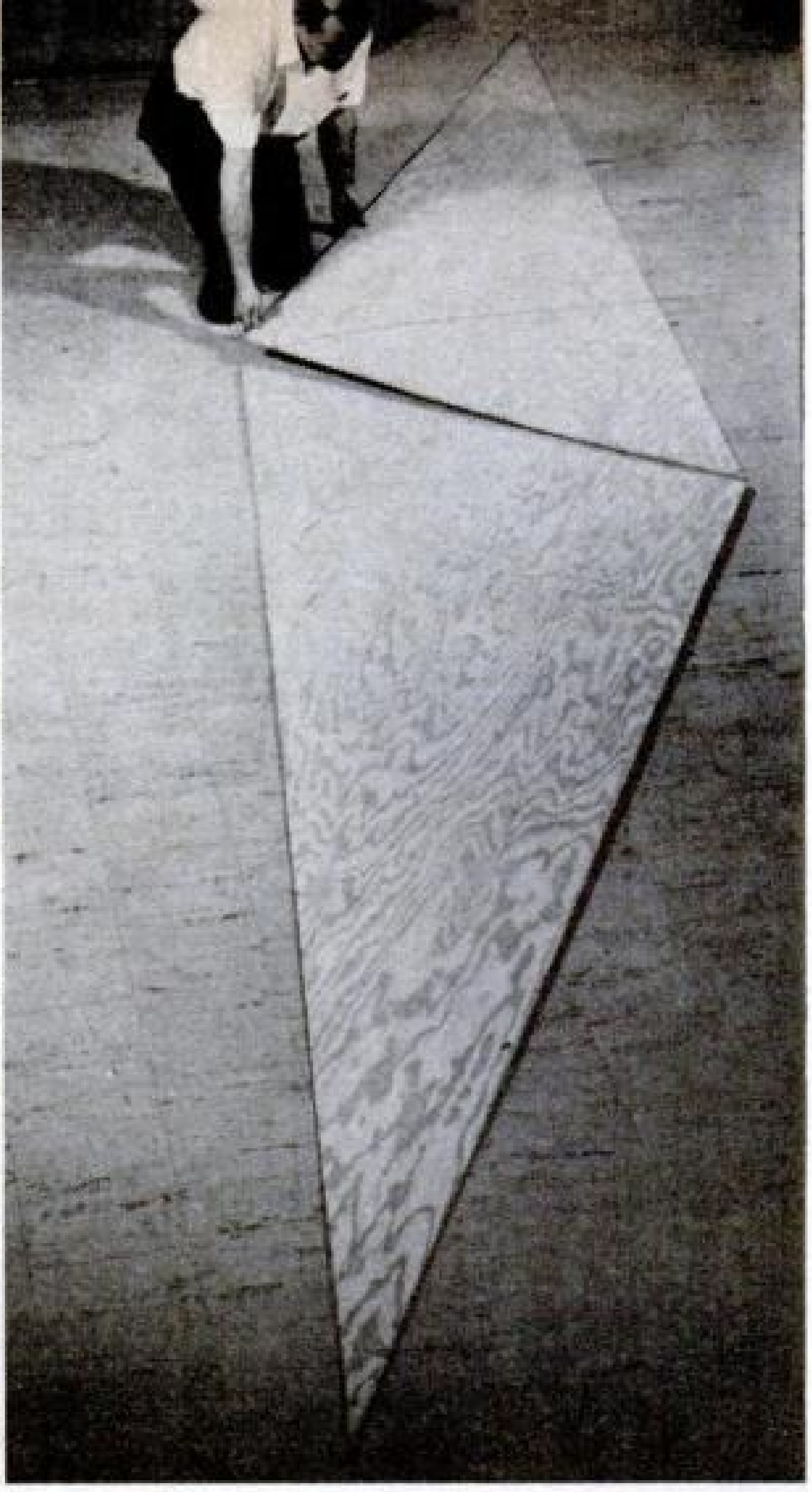
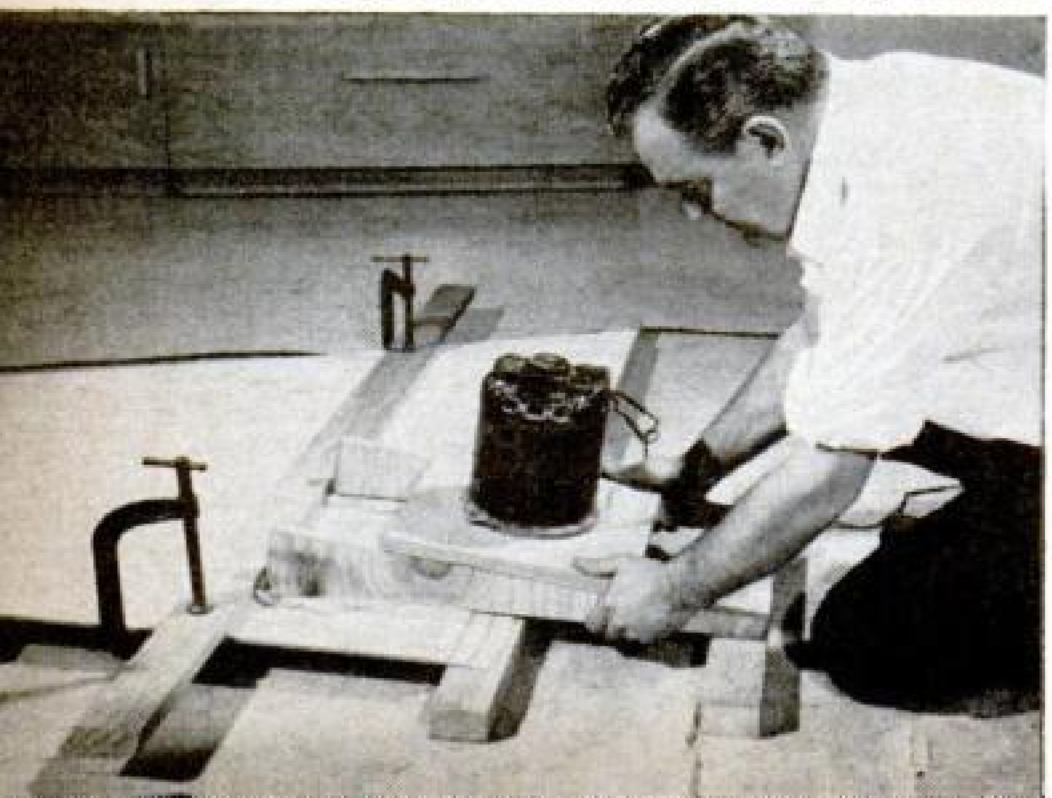


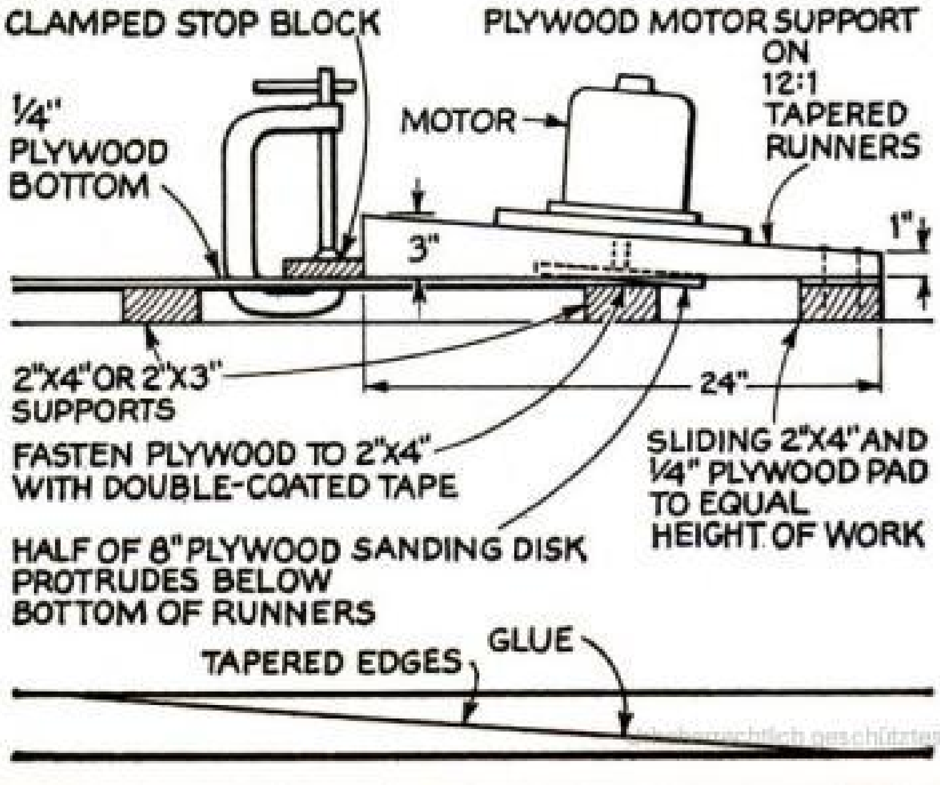


Diagonal cutting is the key to getting the 15′ bottom out of one 4′-by-8′ sheet of plywood. This divides the sheet into two triangles. When the triangles are placed base-to-base, as at right, they form a diamond more than 16′ long. The bottom is then cut from this diamond. The triangles can be butt-joined or fastened with the special scarf joint shown below.

For a really strong, slick bottom seam, try this scarf joint

A scarf joint, made by gluing thinly tapered edges in an overlapping splice, is used by plywood makers for joining standard panels into extra-long ones for boat-building. It's fussier than a simple butt joint, but is stronger and much neater looking. The setup shown here lets you make the edge tapers easily with a disk sander. The sander (or any motor with a sanding disk on it) is mounted on tapered runners to cock it at a slight angle. A slant of 12:1 gives a good 3″-wide taper on ¼″ plywood. Slide the sander along the runners until half of the disk protrudes below them, then fasten it in place. Move the rig in and out against the edge rather than crosswise along it. To set up a depth stop, move the sander forward until the disk just touches the edge. Mark where the fronts of the runners come, then measure ahead 3″ and clamp on a crossboard. When the runners hit this board, the disk will have made the 3″-wide taper. Use the coarsest sanding disk you can find or cut a circle from a sheet of floor-sanding paper. Remember to taper the two pieces on opposite sides. Coat both tapered edges with resorcinol glue and tack together against a two-by-four with newspaper in between. Place another two-by-four on top with newspaper in between and clamp for 48 hours.





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to handle both in and out of the water. Weighing only 80 pounds, the hull is a cinch for car-topping. Its flat bottom and straight sides may not be particularly pretty, but they make for sure-footed stability in rough waters and are simple to make. You can check all your fits with a framing square—there are no tricky curves or offsets to fuss with.

Construction pointers. Exterior-grade plywood is adequate and much cheaper than marine grade. All of the seams are joined with a resorcinol resin glue, such as Elmer's boat glue. Orginally developed for building PT boats, this two-part, mix-before-using type of adhesive is a major reason for the hull's great strength and watertightness. It not only provides a strong structural bond, but it also serves as a waterproofer, crack filler, and general patching compound.

The halves of the hull bottom can be joined in two ways. You can use the simple butt joint shown in the blueprint or the fancier scarf joint shown in a separate photo and drawing. If you choose the butt joint, note that reinforcing strips for it are cut from waste pieces trimmed off the original diamond. These are shown as shaded areas on the blueprint. If you choose the scarf joint, make frame No. 4 ¼" higher since there'll be no bracing strips for it to sit on.

The frames are laid out upside down, as shown, and the chine strips are glued on around the edges. This establishes the oval shape for the bottom. To cut out the bottom, you simply lay the plywood diamond on top of the upside-down frames, tack it temporarily in a few places, and trace around the chines to transfer the outline to the plywood. When you saw out the bottom along this outline, it will fit perfectly.

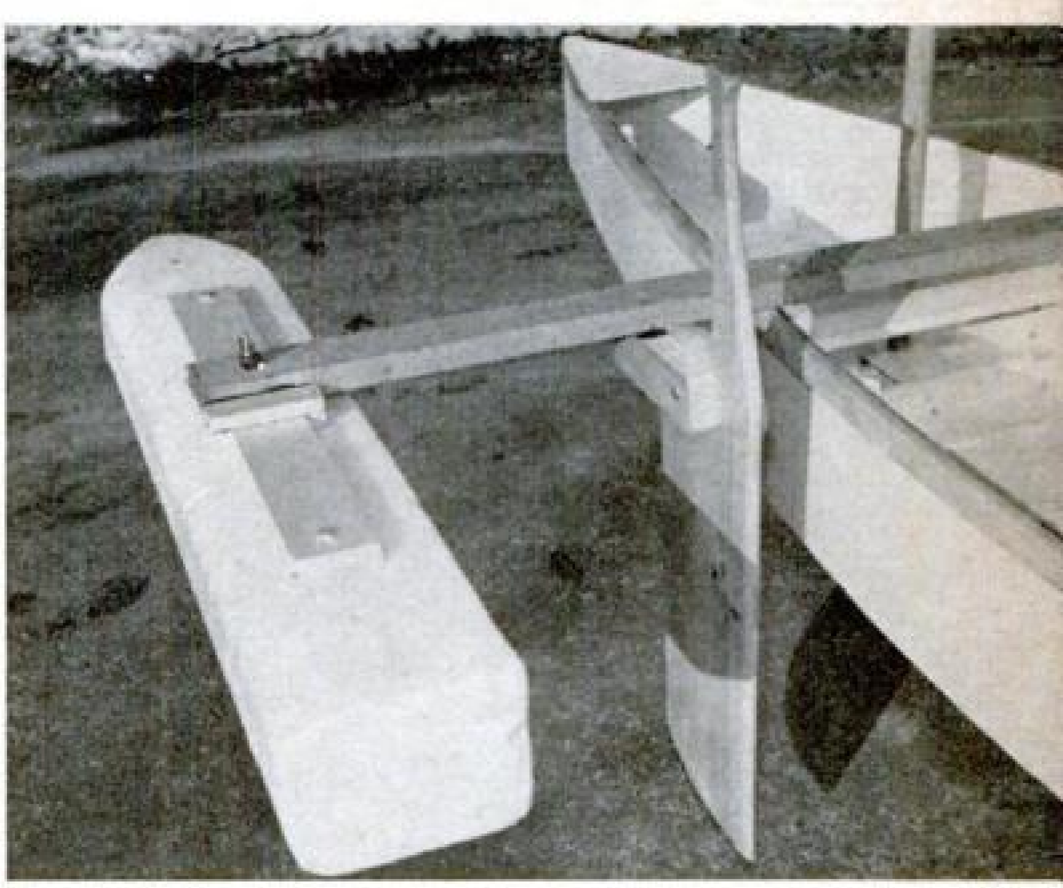
Use small brads at all joints to hold the parts together while the glue cures. At major joints, you may prefer to use copper nails or brass screws. You'll find it necessary to do a little hand-fitting where the chines meet the frames and the bow and stern blocks. Use a fine-tooth saw and rasp for this. Finish up by smoothing all joints with a sanding disk. The side edges of the frames should be beveled slightly toward the ends of the boat.

Note that the reinforcing strips on the bottom and side planking must be trimmed back a bit short of the edges so as not to interfere with the chines. Don't, incidentally, omit the rub-rail strips. These are not just for looks, but add important bracing to the upper rim of the hull.

The running gear. The single leeboard is sufficient to act as a keel and keep the boat from side-slipping in the wind. It and the rudder are both pivot-mounted so they swing up automatically if you hit an obstruction. Their curves are not critical and can be cut freehand.

[*Continued on page 196*]

Weighing only 80 pounds, the hull is easily hefted onto a car top for a run to the nearest lake. Its 15' length can be handled by anything from a compact sedan to a full-size wagon.



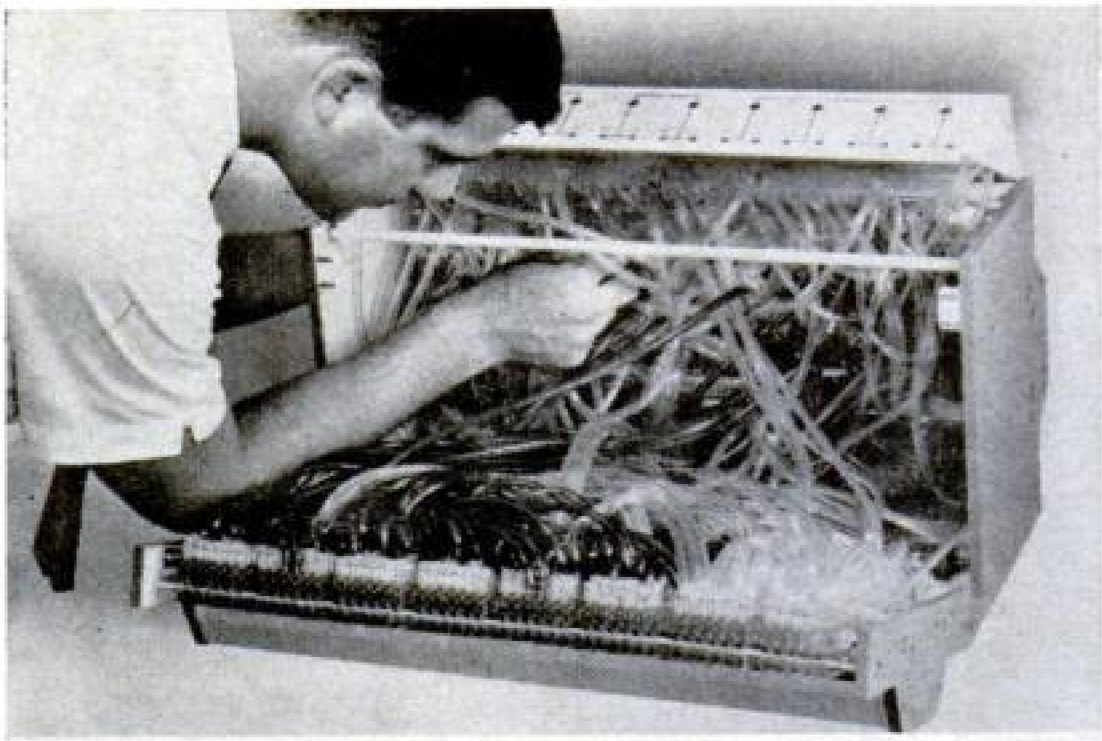
Pontoons and leeboard mount on a two-by-four crossbar held on by only two bolts and wingnuts. Two-by-four blocks glued inside the gunwales provide anchor points for the bar.

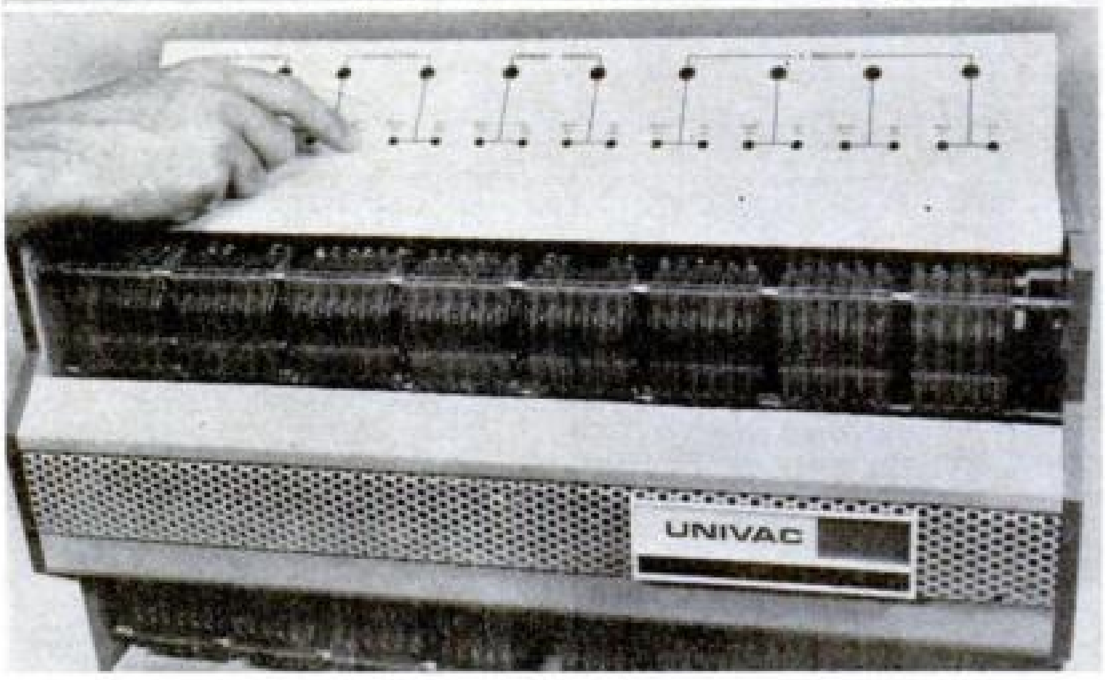
Tilt-up rudder pivots on a single bolt so it retracts automatically if you hit an obstruction or run onto a beach. Stiffeners glued to its sides keep it from splitting and warping.

Radio-controlled outboard steers barges from bow

Pushed from behind and steered from the front, strings of barges over three blocks long now make the intricate bends of the Mississippi River with no sweat.

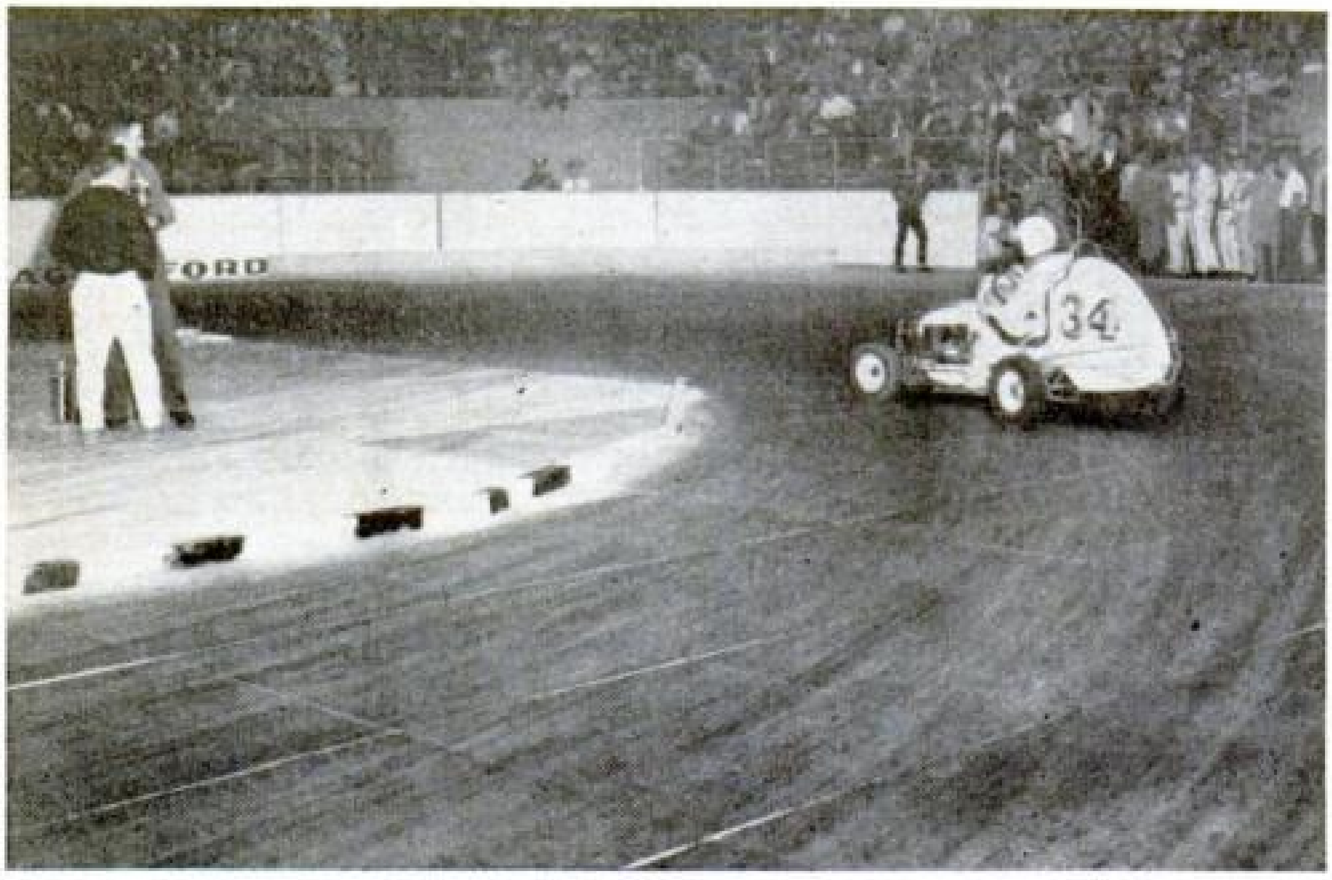
Controlled by radio from the tug behind the load, Cargo Carriers' bow steerer is an 80-foot unmanned, rudderless boat with a diesel-driven propeller turning in a well like an outboard motor.





Non-electronic computer works on air

Air flowing through plastic tubing enables this digital computer to perform these basic functions: memory, arithmetic, control, input, and output. It uses no electricity, has no moving parts. Programs and operating instructions are fed into the air-powered Univac by covering appropriate openings (lower photo) to change pressure in the elements. Read-out is from openings at the top of the panel.



Midget cars race on plywood track

The indoor track for midget racers at left is made of interlocking plywood parts. It can be dismantled and trucked to any city where a racing meet is scheduled.

The 1/10-mile track is built of U.S. Plywood's resin-and-fiber-surfaced grid-pattern Permaply. It provides good traction, is easy on tires, stands up under skids at 80 m.p.h.

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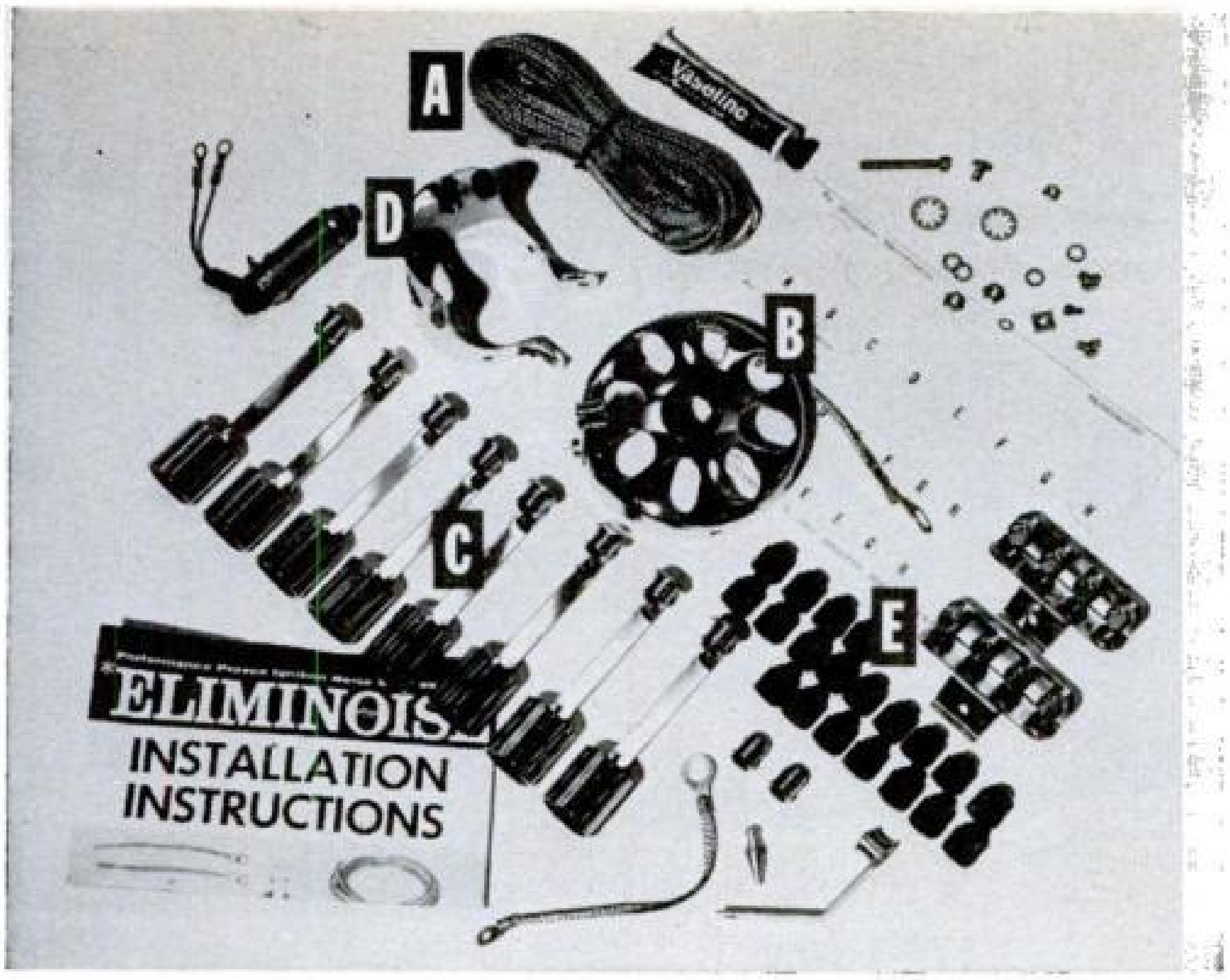
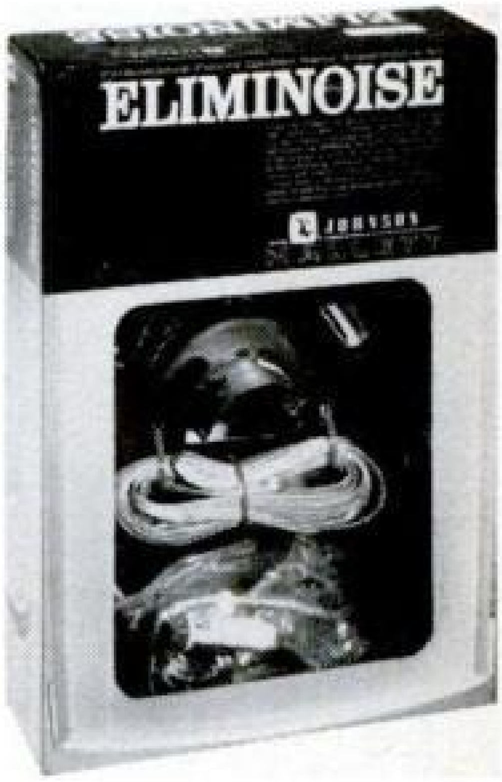




How to hush ignition for mobile CB

THE noise radiated by the ignition systems in modern cars and trucks—especially transistorized units—can make a vehicle-mounted Citizens Band two-way radio sound like an outboard motor. The noise suppressor kit shown unpacked above supplies you with everything you need to keep a mobile CB rig quiet:

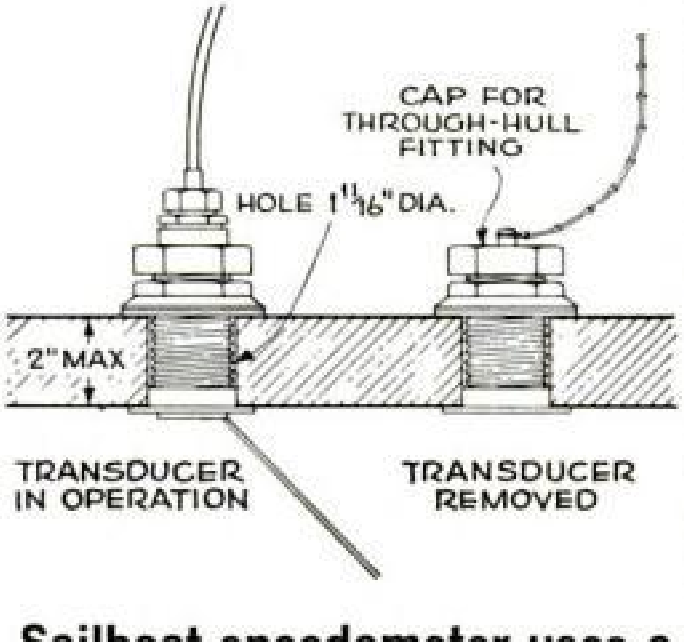
Included in the kit are A) shielding braid for spark-plug cables, B) a distributor shield, C) spark-plug shields, D) a coil shield and filter condenser, and E) cable guides and hardware.

Price: About $30 for six-cylinder engines; $35 for eight-cylinder engines. The Johnson Co., Waseca, Minn.

Now they pack tubes in "pop-top" cans

Problem: How to protect fragile—and expensive—vacuum tubes for radar and communications systems from breakage.

Solution (by American Can Co.): quick-opening pop-top cans lined with shock-absorbing foam.



Sailboat speedometer uses a strain-gauge speed sensor

This speedometer is a commercial version of the "secret weapon" used by the Constellation during her successful defense of the America's Cup last summer. It computes sailboat speed by measuring the force of water moving past a brass wand extending through the boat's hull. A strain-gauge transducer reacts to the water's push against the wand—its output signal depends on the wand's speed through the water. Speed readings are displayed on a three-scale meter mounted in the boat's wheelhouse. The sensor wand, if damaged, can be replaced while the boat is underway. About $375. Raytheon Co., South San Francisco, Calif.

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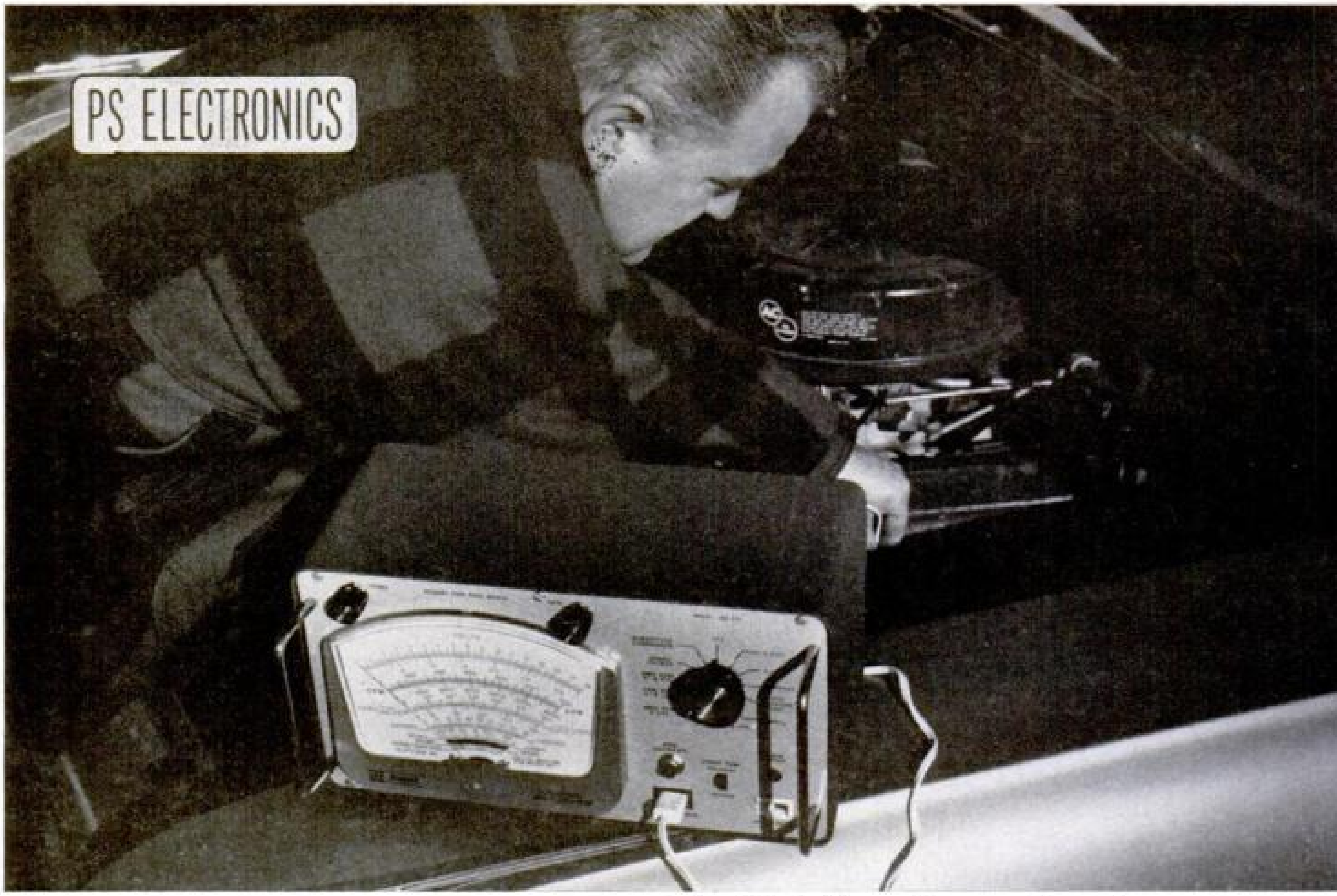

The Knight-kit analyzer packs eight test instruments into one case. Price: $49.95. Building time: six to eight hours. Performance: Its accuracy equals that of a commercially built analyzer.

Personal-use report:

An Auto-Engine Analyzer

By Ronald M. Benrey

WHAT'S an auto-engine analyzer? It's a single piece of test gear that contains most of the instruments you'll need to keep your car engine in tune, and trouble-shoot it if something goes wrong:

- A dual-range tachometer: 0-1,200 r.p.m. for adjusting the carburetor idle setting; and 0-6,000 r.p.m. for checking spark advance and transmission shift points.
- A dwell meter for setting, and periodically checking, ignition-point gap.
- A voltmeter and ammeter for testing the battery, generator, and voltage regulator.
- An alternator diode tester.
- An ohmmeter continuity checker for wiring, light bulbs, ignition coil.
- A spark-output tester that measures the energy of ignition sparks and pinpoints faulty spark-plug cable insulation, distributor caps, and rotors.
- A substitute ignition capacitor.

A pro mechanic will tell you his analyzer is indispensable. He probably will add that a good one costs over $100. That's true, if you buy a commercially built one.

If you are willing to wield a screwdriver and soldering iron for an afternoon, as I did, you can build your own analyzer for $49.95. Everything you need—right down to precut and stripped hookup wire and a hank of solder—comes in the Knight analyzer kit. It's sold by Allied Radio Co., Chicago.

How good is it? The finished analyzer is as accurate as any ready-made unit you'll find on a garage workbench. Its tach circuit uses a Schmitt-trigger pulse-counting circuit that isn't affected by temperature

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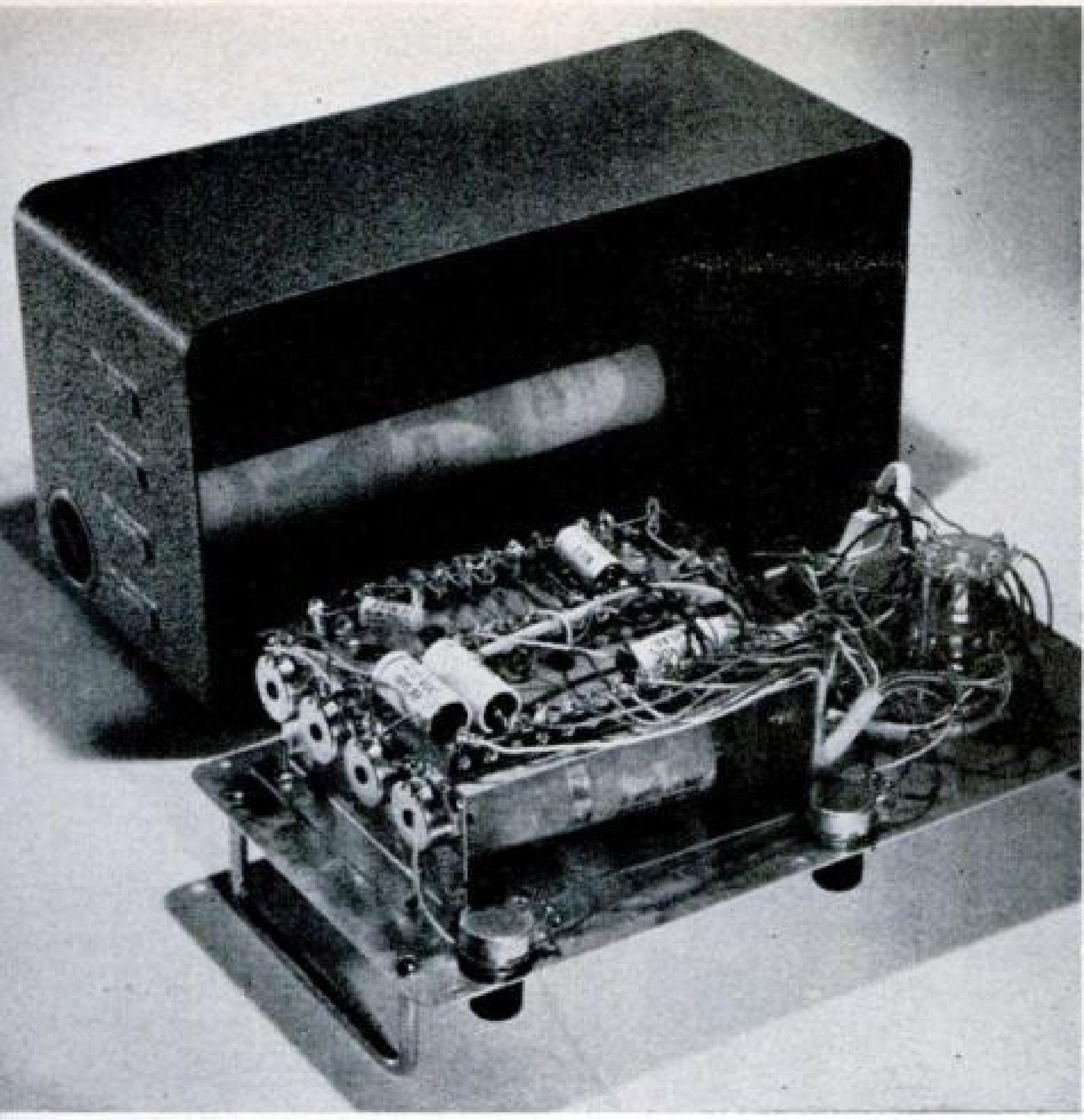
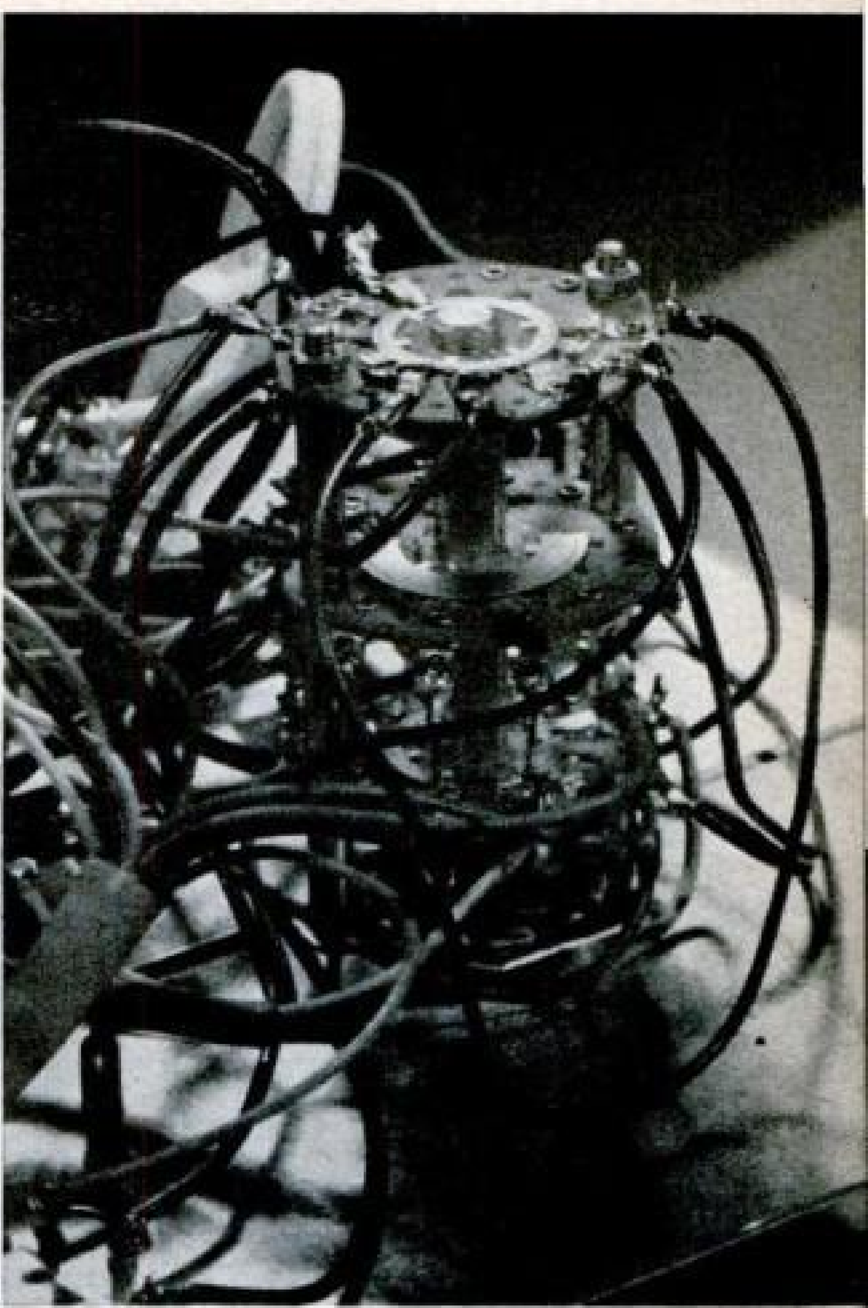




Heart of the analyzer is this three-transistor circuit powered by four flashlight cells. The main chassis is uncluttered and easy to wire. Top quality components are used in the circuit.

Don't be afraid of this rat's nest. The analyzer's 12-position function switch looks more complicated than it really is. Take your time, wire carefully, and you'll avoid mistakes.

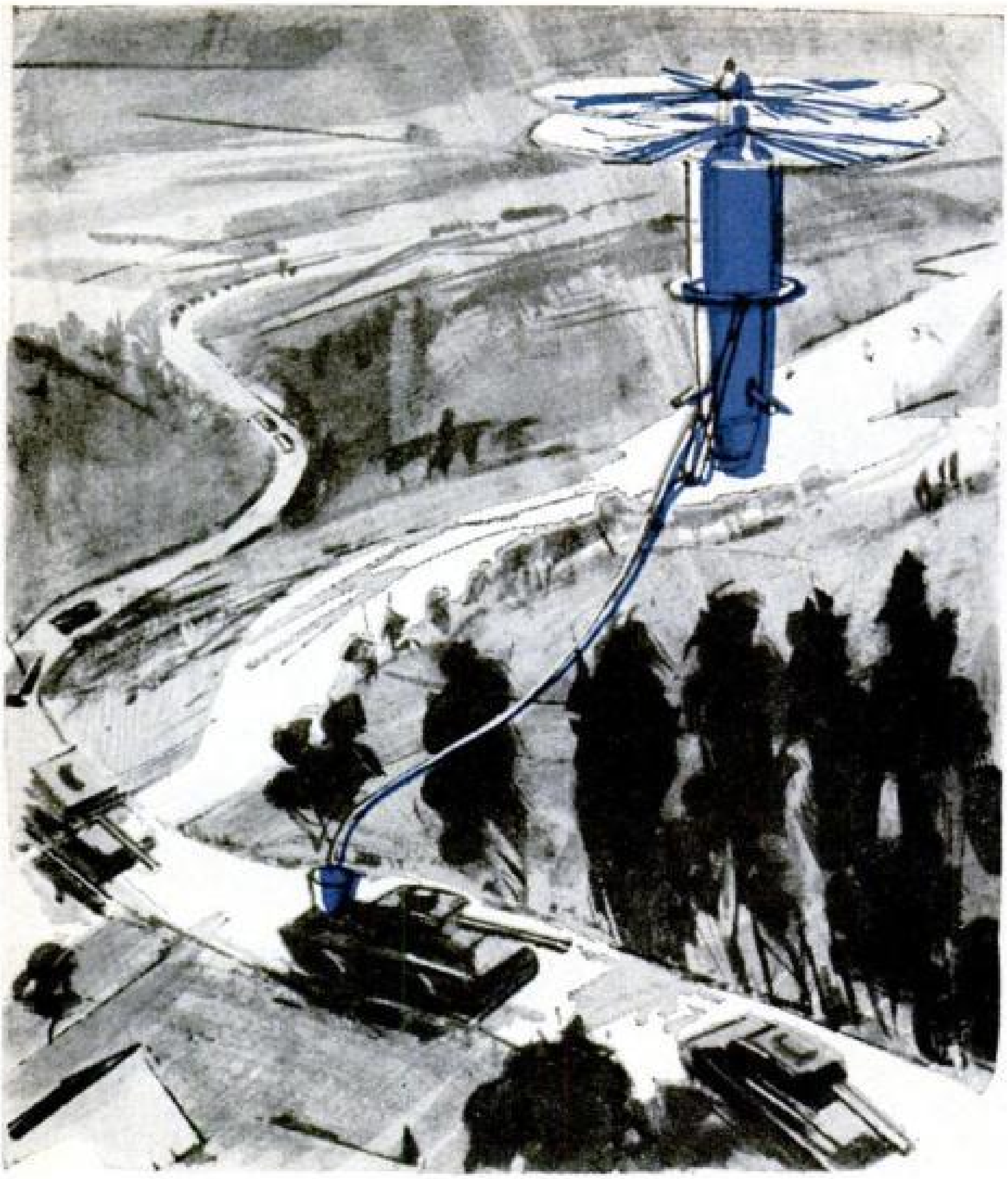
You Build from a Kit

changes—tach accuracy isn't temperature-sensitive. That's important if you use the unit outdoors. A front-panel control compensates for changes in battery voltage, so the tach calibration stays accurate as the batteries age.

Both the tach and dwell circuits are calibrated for six- and eight-cylinder engines; for four-cylinder engines, multiply the reading on the eight-cylinder scale by two.

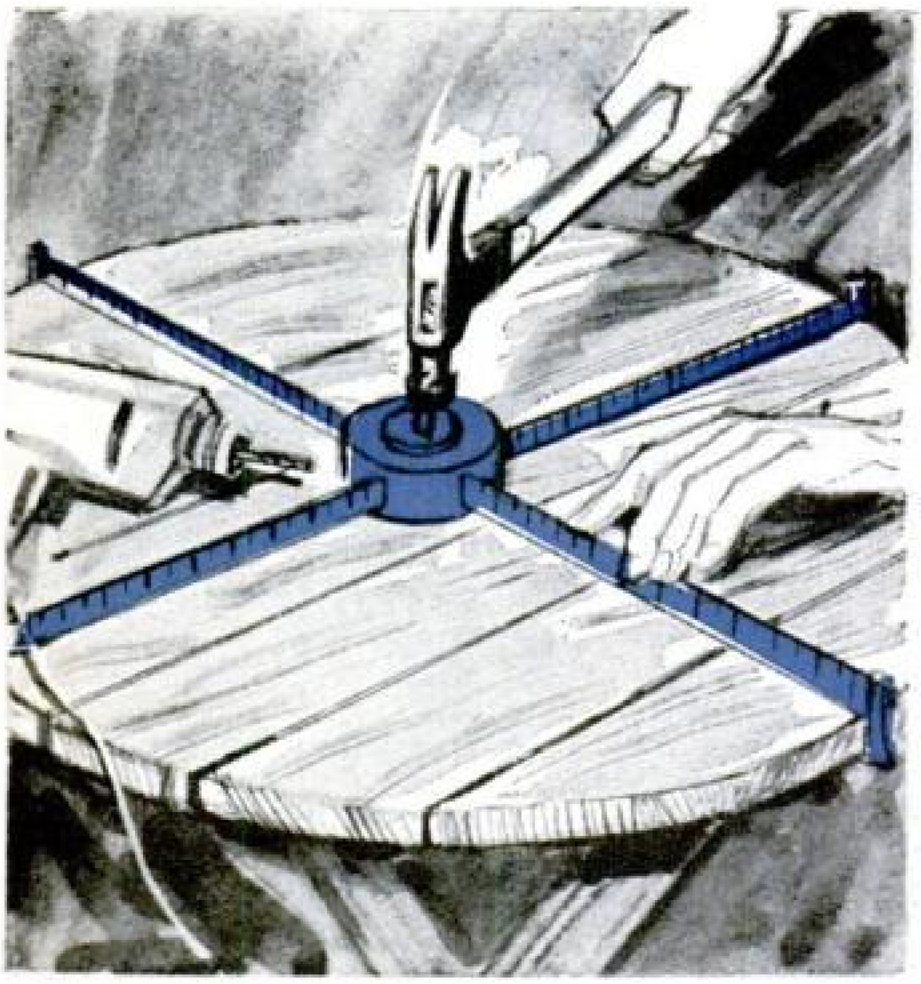
The instruction manual is well illustrated and easy to follow.

The meter face (left) has an easy-to-read three-color scale. A nice touch: Roll handles on the front protect it. A sour note: There's no carrying handle on top—the unit really needs one. A deep storage compartment in back (below) is handy for storing accessories.

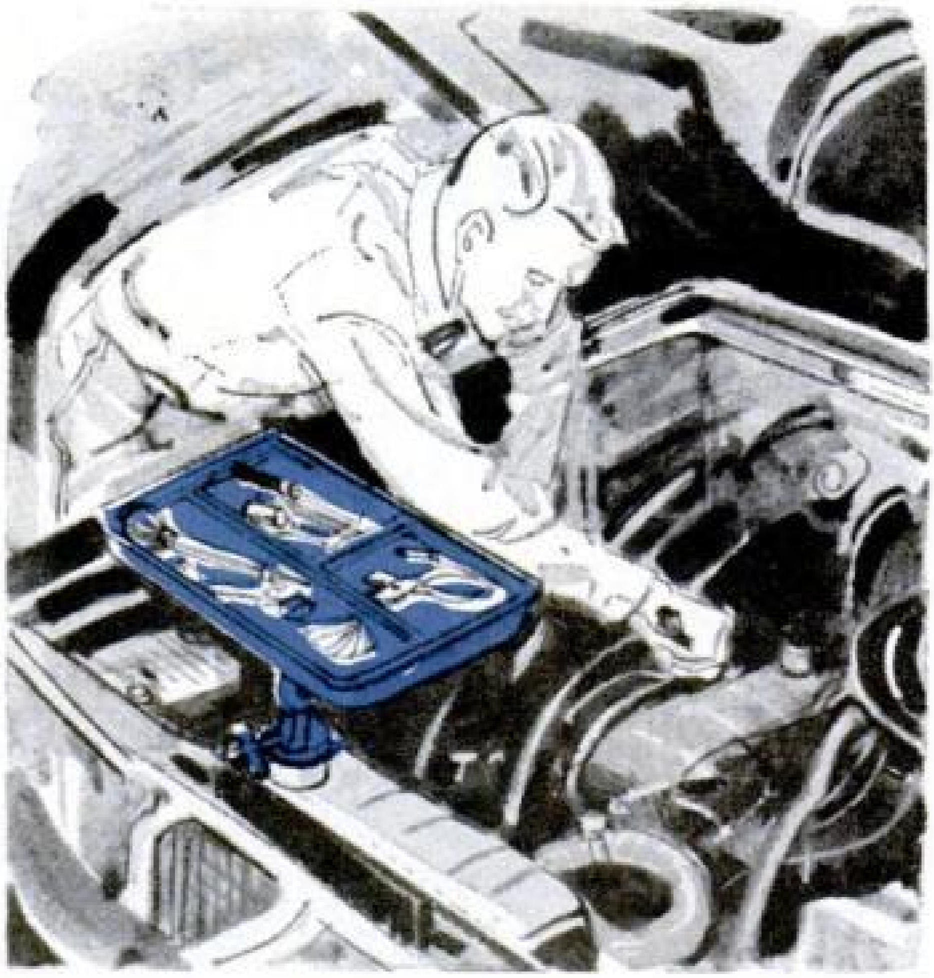


New Ideas from the Inventors

Props extend camera's eye. TV carried aloft by this recently patented hovering platform might give soldiers on the ground a wider view of targets or hazards. Powered through a tethering cable, electric motors would turn counterrotating props to lift the platform from a cradle on the control vehicle (a tank here). Larger—possibly civilian—versions might be used as cranes for hoisting jobs.



Ruler legs find center. Four steel tapes coiled in a common case would let you find the center of any round or regular surface, or of a large hole or opening. The tapes of this pocket-size tool would wind around a hub. You would mark a center by tapping a punch centered and collared inside the hub of the case.



Tool tray clamps above engine. Tightened by a thumbscrew, the clamp on this tool tray would grip a car's radiator cap to keep an assortment of tools handy for repair or service. A universal joint would let you level the tray on a nonvertical filler cap, or turn or angle it to keep tools convenient to your hand as you work.

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Hose powers garden spray. You'd meter fertilizer (or insecticide) from this hopper by adjusting hose pressure and pressure in a tube that deflects water to the bottom of the hopper. Pressure differential, created by different-size passages in the T joint, would draw dissolved solids up the inlet tube into the spray stream.

Wheels turn cans into train. With wheels like these snapped on, empty cola and beer cans could form the car bodies of a train set. Molded-plastic wheels and simple wire clamps would make up the basic structure; couplings, lights, and other items could let kids add detail and decoration to the low-cost do-it-yourself toys.

Folding dock travels with you. Hinged to fold flat in little space, the metal tubes and plywood deck of this loading platform would fit conveniently into a car or boat, set up quickly—on adjustable legs—on almost any shoreline. The platform would also serve as a diving or sunning board, or even as a convenient family picnic table.

The following patents have been issued on these inventions: **Platform**—*No. 3,149,803 to T. Petrides and W. Stapelfeld, NYC, and O. Stroukoff, Bogota, N.J.;* **Centering rule**—*No. 3,025,608 to D. Hendrix, Morganton, N.C.;* **Tool tray**—*No. 3,023,063 to P. Hansen, Los Angeles;* **Spray gun**—*No. 3,123,362 to G. Elvers Sr., Tampa, Fla.;* **Toy train**—*No. 3,154,882 to E. La Bossiere, Los Angeles;* **Portable dock**—*No. 3,106,826 to R. Freidel, Vancouver, Wash.; W. Upton, Portland, Ore.*

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington, D.C. 20231, at 25 cents each. To write to an inventor, if the address above is insufficient, address him (by name and patent number) in care of the Commissoner of Patents.

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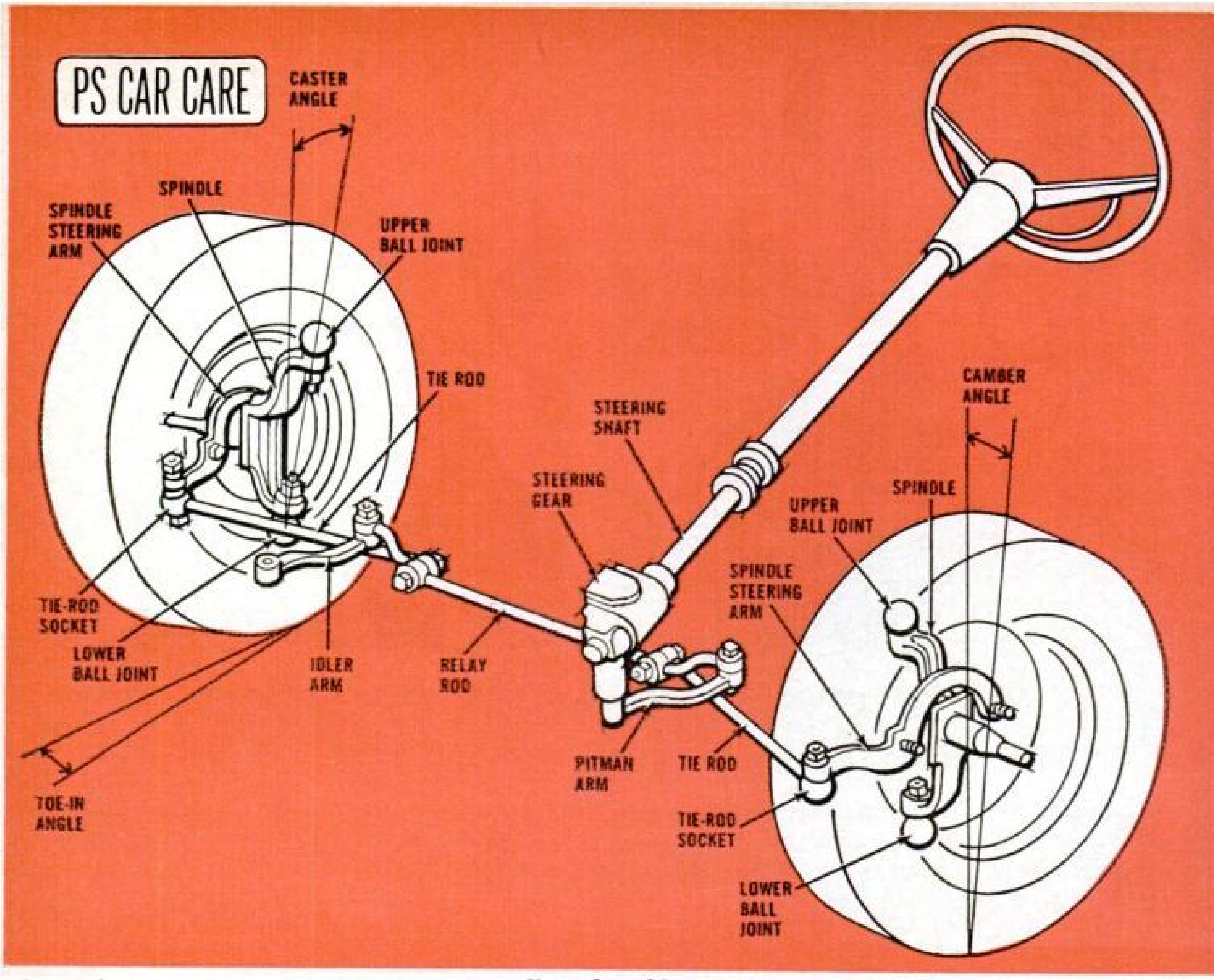

The Ackerman steering system is universally used in automobiles: The front wheels are mounted on independent, pivoted spindles—or knuckles—that are tied together by a parallelogram steering linkage. The system shown in the drawing above is from a 1963 Chevrolet.

Straightening Out

Your car's steering system needs occasional adjustment to keep you in control

By Frank Greenwald

DOES your car go where you steer it? Or does the steering wheel seem to have a mind of its own? Your car's "wanderitis" can probably be traced to excessive play or looseness in the steering system:

- A loosely adjusted steering-gear unit, causing steering-wheel sloppiness.
- Worn idler-arm joints, making the

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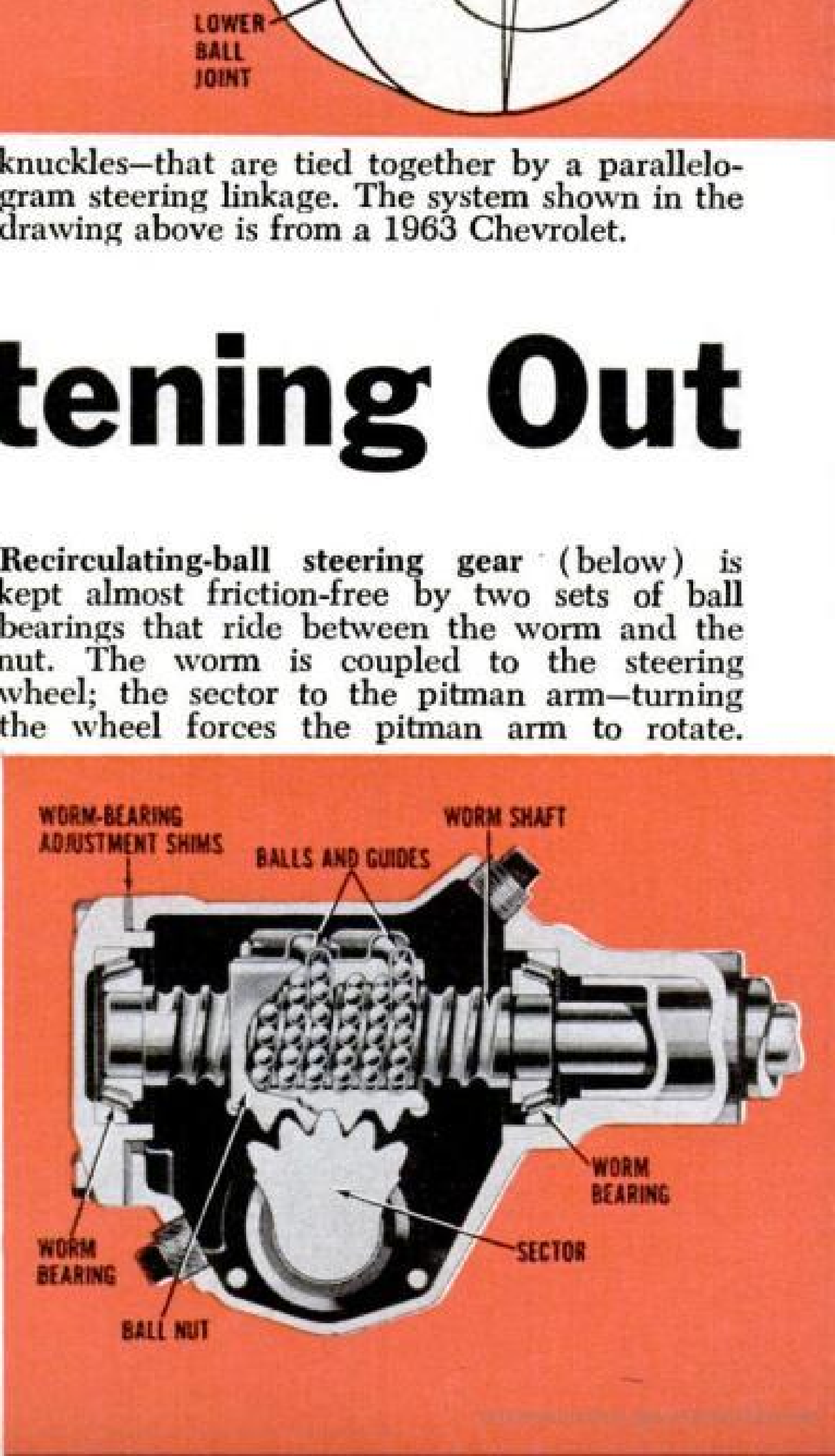
Recirculating-ball steering gear (below) is kept almost friction-free by two sets of ball bearings that ride between the worm and the nut. The worm is coupled to the steering wheel; the sector to the pitman arm—turning the wheel forces the pitman arm to rotate.

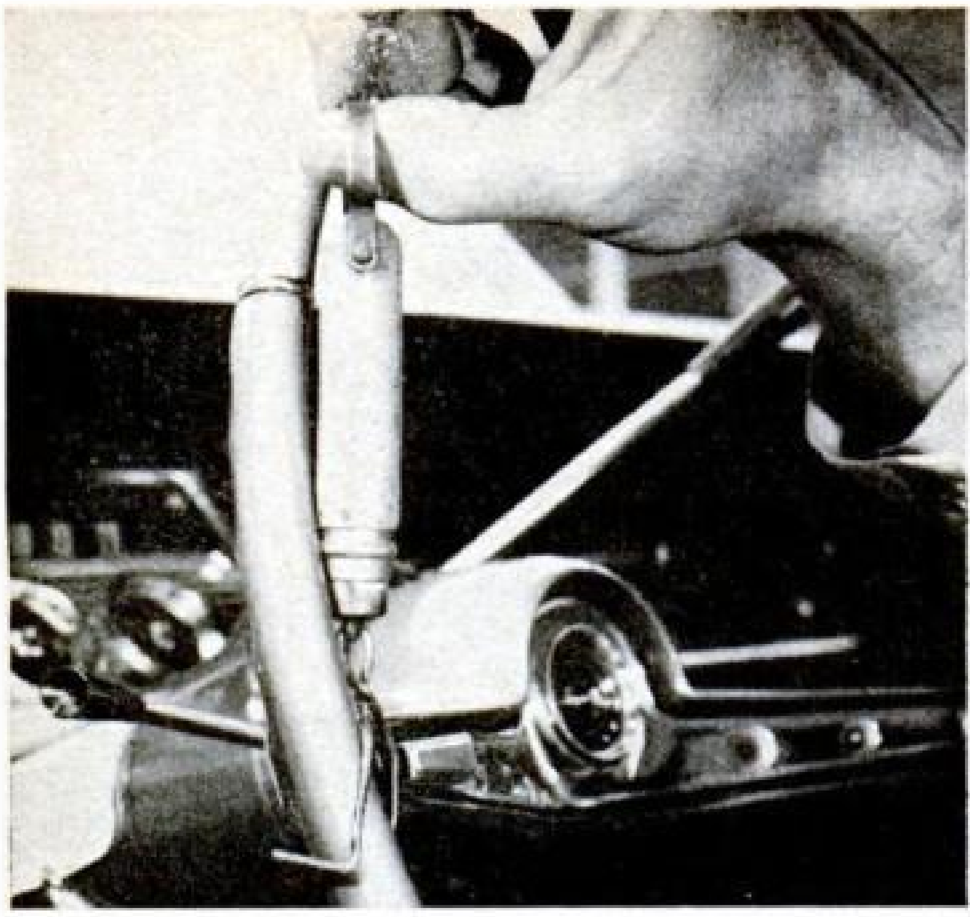


Sloppy steering is a symptom of excessive play or looseness somewhere in the steering system. The most likely culprits: too much play between sector and ball nut in the steering gear, steering-gear worm bearings loosely adjusted, loose steering linkage, and worn ball joints.

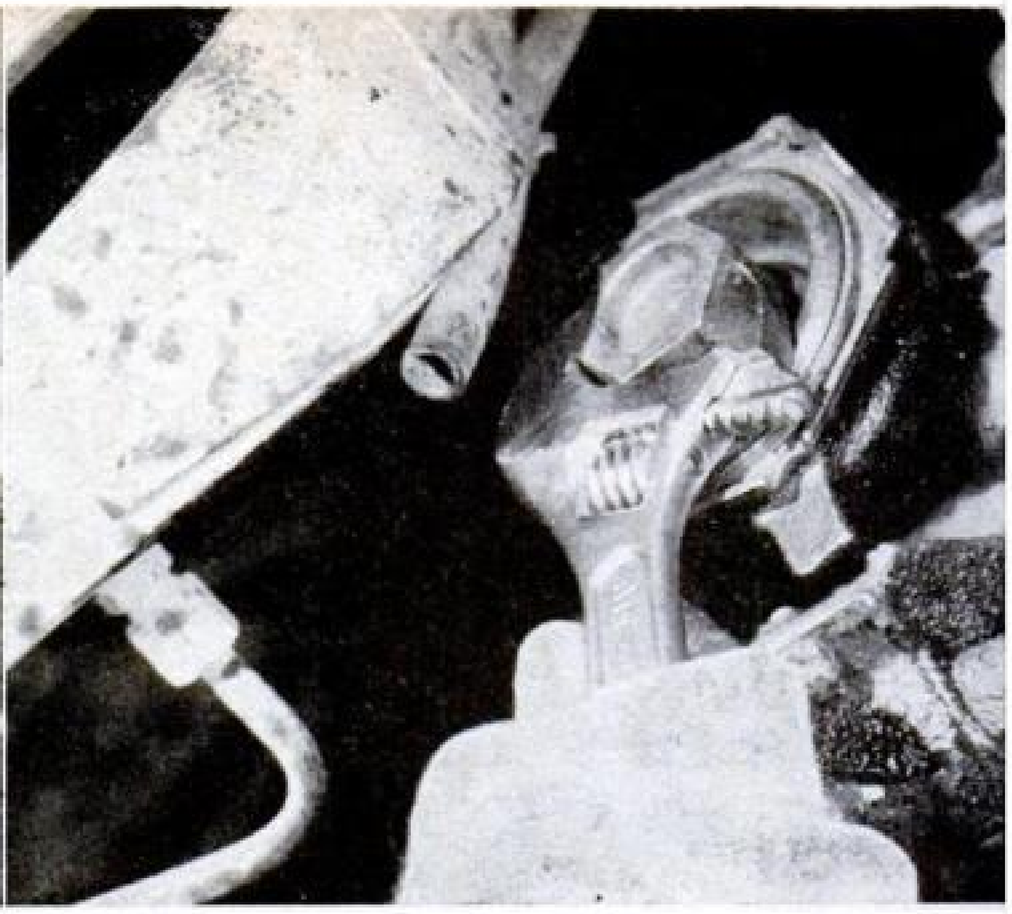
a Steering System

The pitman arm engages the sector shaft by means of a tapered spline connection, and is held in place by a lock washer and nut. To remove the arm use a puller that bears against the end of the shaft. Don't hammer against the shaft, or force a wedge between arm and gear housing.

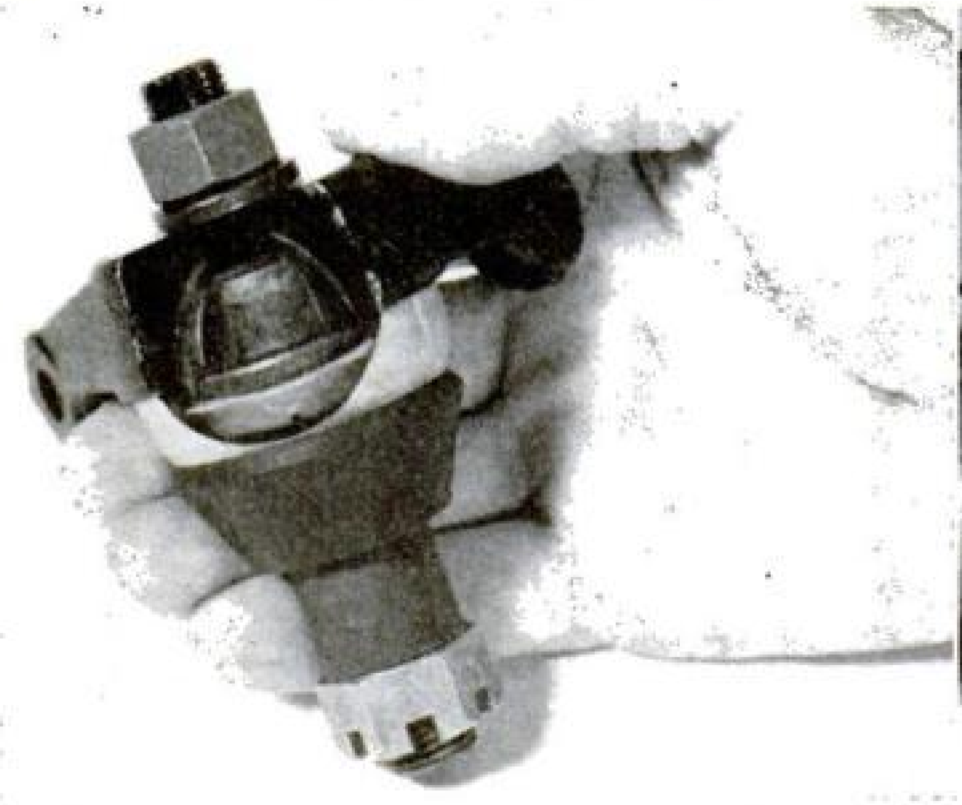
Checking worm-bearing preload: Loosen lash-adjuster screw and back it out several turns. The mark on the worm shaft is the steering-gear high point—front wheels straight ahead. It should be lined up with the indexing tab on the coupling between worm shaft and steering shaft.



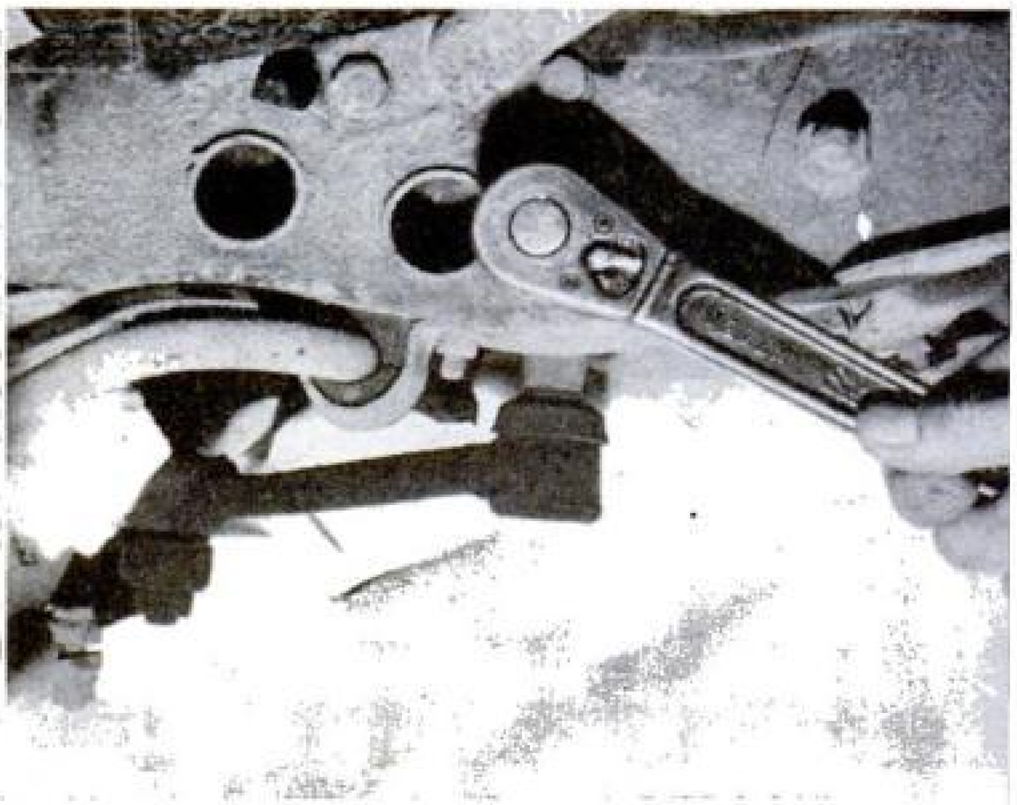
A simple utility scale is perfect for measuring steering-wheel turning resistance (pull at wheel rim) when adjusting worm-bearing preload and sector lash. Hint: Paint white lines on the ½-lb. and 1½-lb. markings. Be sure the scale is at right angles to the spoke it's pulling.



The worm-bearing preload adjuster is usually a threaded insert that screws into the gear housing and presses against the outer cup of the lower worm bearing (a few gears use shims). Use a brass drift and a hammer, or a large wrench, as above, to loosen the adjuster's locknut.



Replacement ball joints often have plus features not found on original-equipment joints. The joint above has a nylon preload bushing that prevents false indications of looseness. The bearing automatically adjusts for wear in all directions. This one is made by Toledo Steel Products.



The idler-arm installation shown above is typical of most cars. The idler-arm support is fastened to the car frame with two bolts. The other end of the idler arm is connected to the relay rod: A stud on the idler arm engages a tapered hole in the relay rod, held in place by a nut.

front-wheel toe-in settings change continuously.

- Worn front-suspension ball joints, causing constantly varying caster and camber.

The steering reduction-gear assembly (or simply, steering gear) is located at the lower end of the steering shaft. It's a miniature gearbox designed to give the driver a mechanical advantage when he steers. It multiplies his moderate pull as he turns the wheel into a powerful torque that drives the pitman arm in a small arc. The steering linkage converts the pitman arm's turning force into a straight-line force that moves the front wheels in the desired direction.

Most manually steered modern cars use recirculating-ball steering gears. An ingenious ball-bearing mechanism makes this type of gear almost free of friction losses: two sets of balls riding in the circular track formed by the worm-and-nut spiral grooves transmit the steering force from the worm to the nut.

The nut moves up and down the worm as

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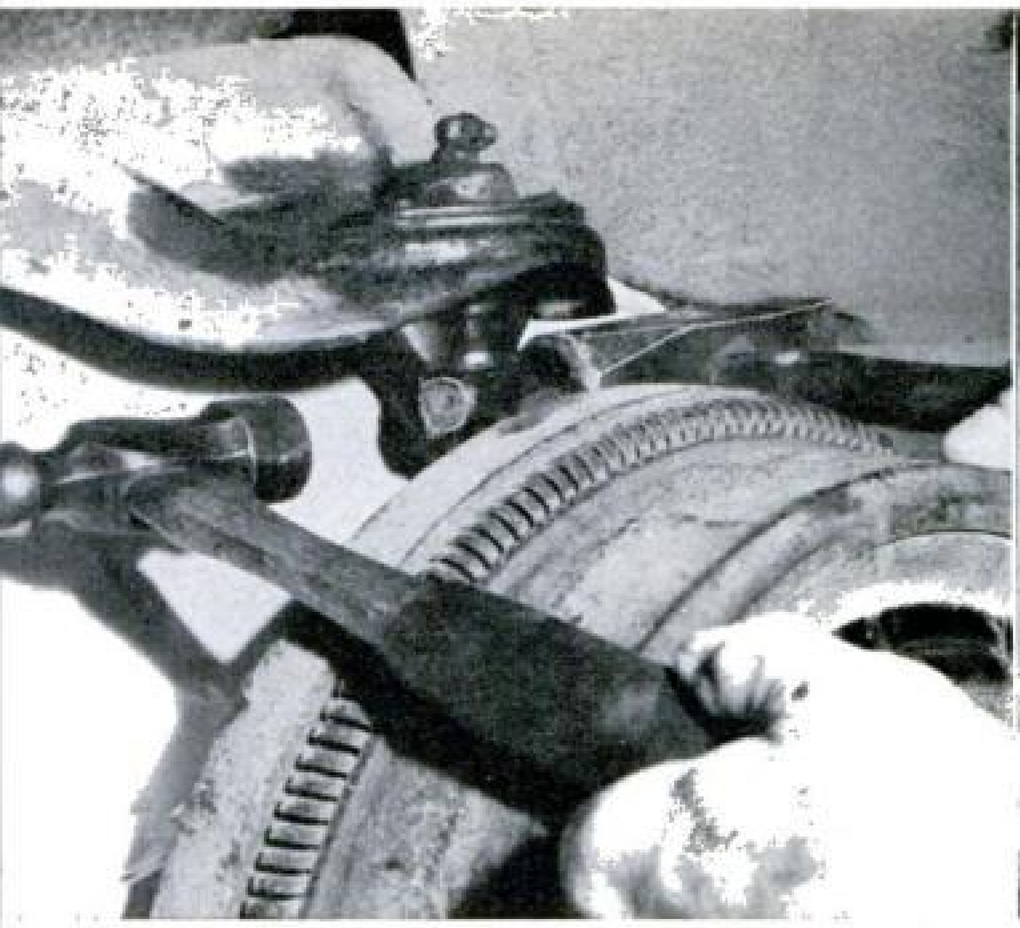
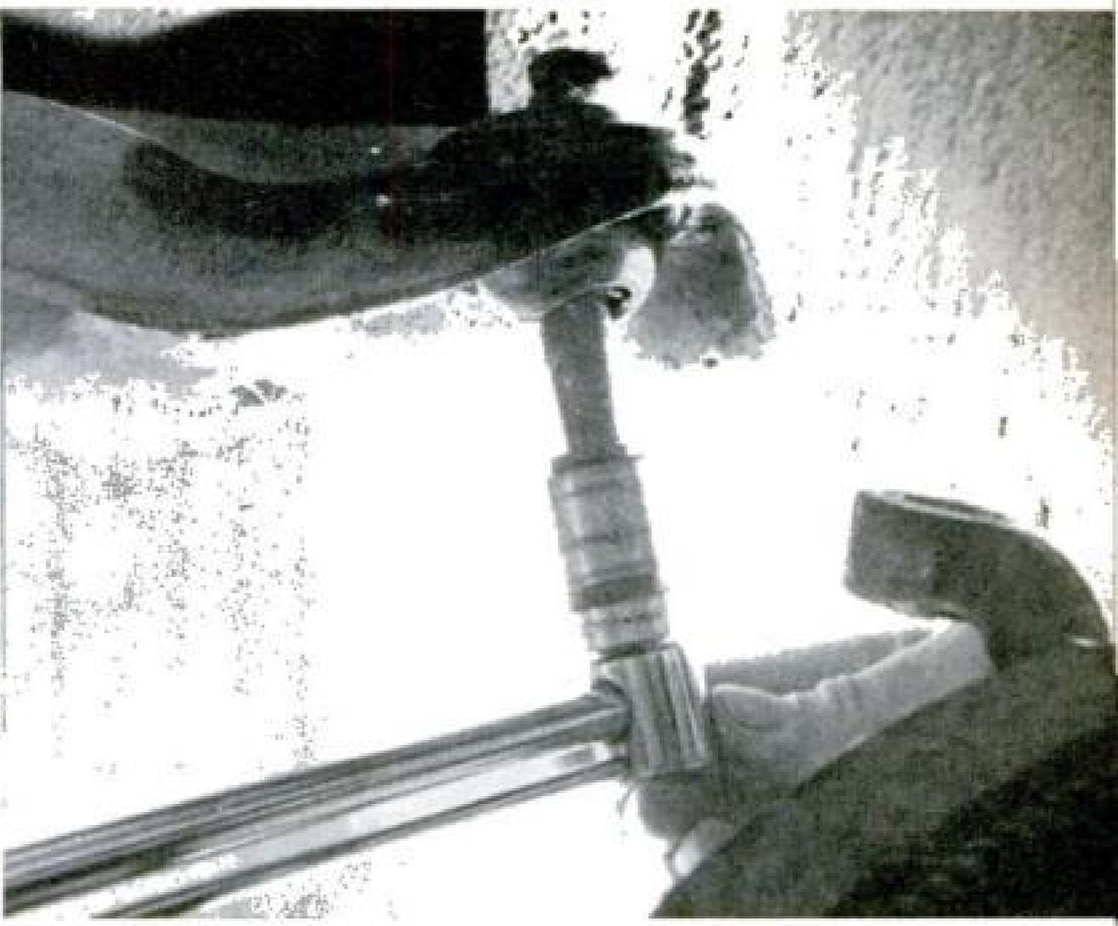
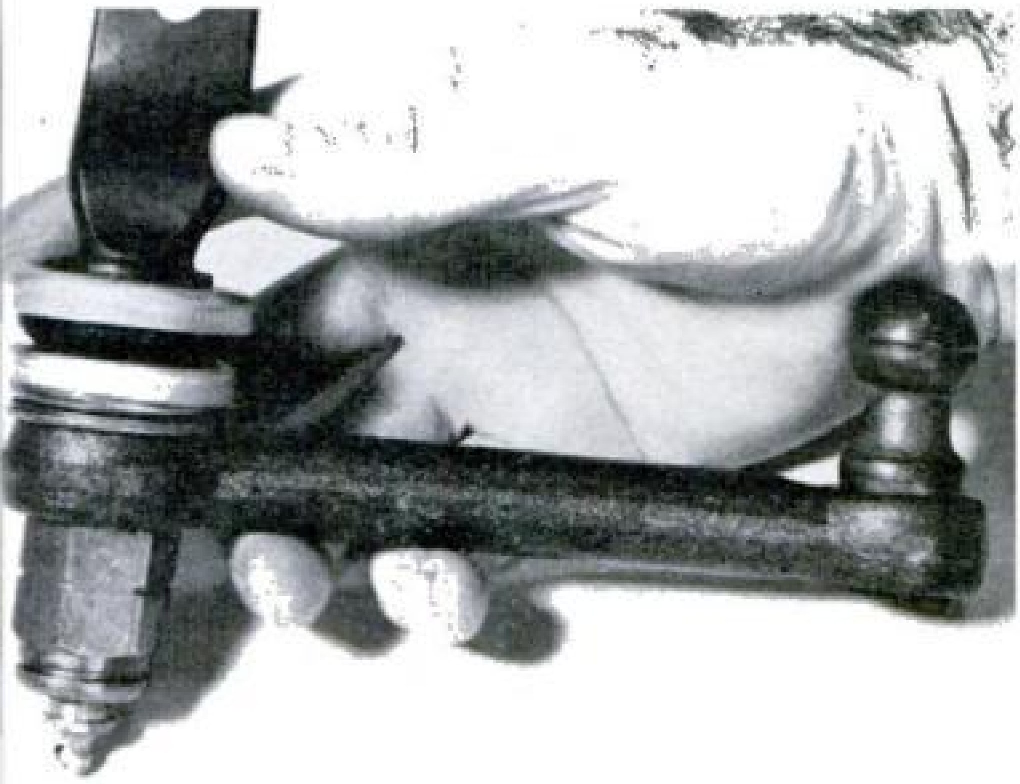


The upper ball-joint stud sits in a tapered hole in the spindle assembly (steering knuckle). To remove it, back up the spindle with a heavy hammer or metal block, and strike it sharply on the flattened area provided for this purpose. Don't give up after just one blow.



To check upper ball-joint torque after it is separated from the spindle, run the stud nut on until it jams at the end of the thread. Use a torque wrench to measure the torque required to turn the nut further. Turning resistance can be estimated with an eight-inch box wrench.



The entire idler arm needn't be replaced if its support bearing is worn—the steel arm forging can be used again. The arm shown in the photo above has been fitted with a low-friction ball-bearing joint made by Toledo Steel Products. It's available in kit form.

The perfectionist can tune his steering system just as he tunes his engine. The cutaway model (above) shows how to install a Toledo Steel Products adjustable thrust bearing in an original-equipment idler arm. The arm's resistance can be adjusted in seconds with a spanner wrench.

the worm is turned by the steering shaft. Gear teeth cut on the nut's face engage the sector, forcing the sector to turn as the nut moves. A pitman-arm shaft joins the sector to the pitman arm.

Steering-gear adjustments. There are two: worm-bearing preload, which sets the overall stiffness of the gear; and sector lash, which adds a bit of stiffness to the steering gear when it's at its high point (corresponding to front wheels straight ahead).

The adjustment procedure given here is typical of most new cars—the photos illustrate the adjustment of a 1962 Chevrolet steering gear. Before tackling your own car, get a shop manual (or *Motor's Automotive Manual*) that details your car's steering system and its adjustments. Then follow these steps:

1. Remove the pitman arm from the sector shaft.

2. Back off the pitman-shaft lash-adjuster screw after loosening its lock nut. This

[*Continued on page 188*]

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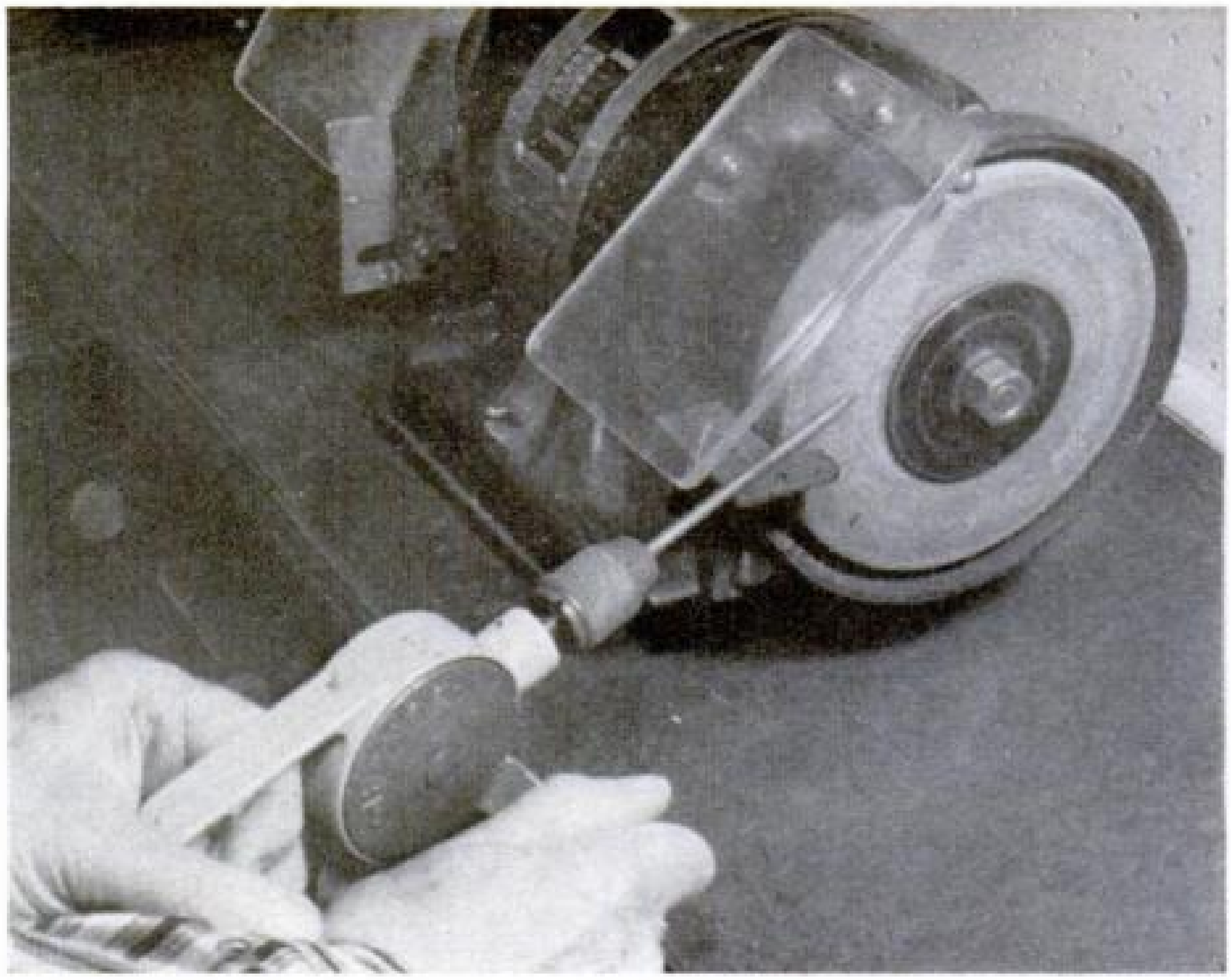
Short Cuts and Tips FROM PS READERS

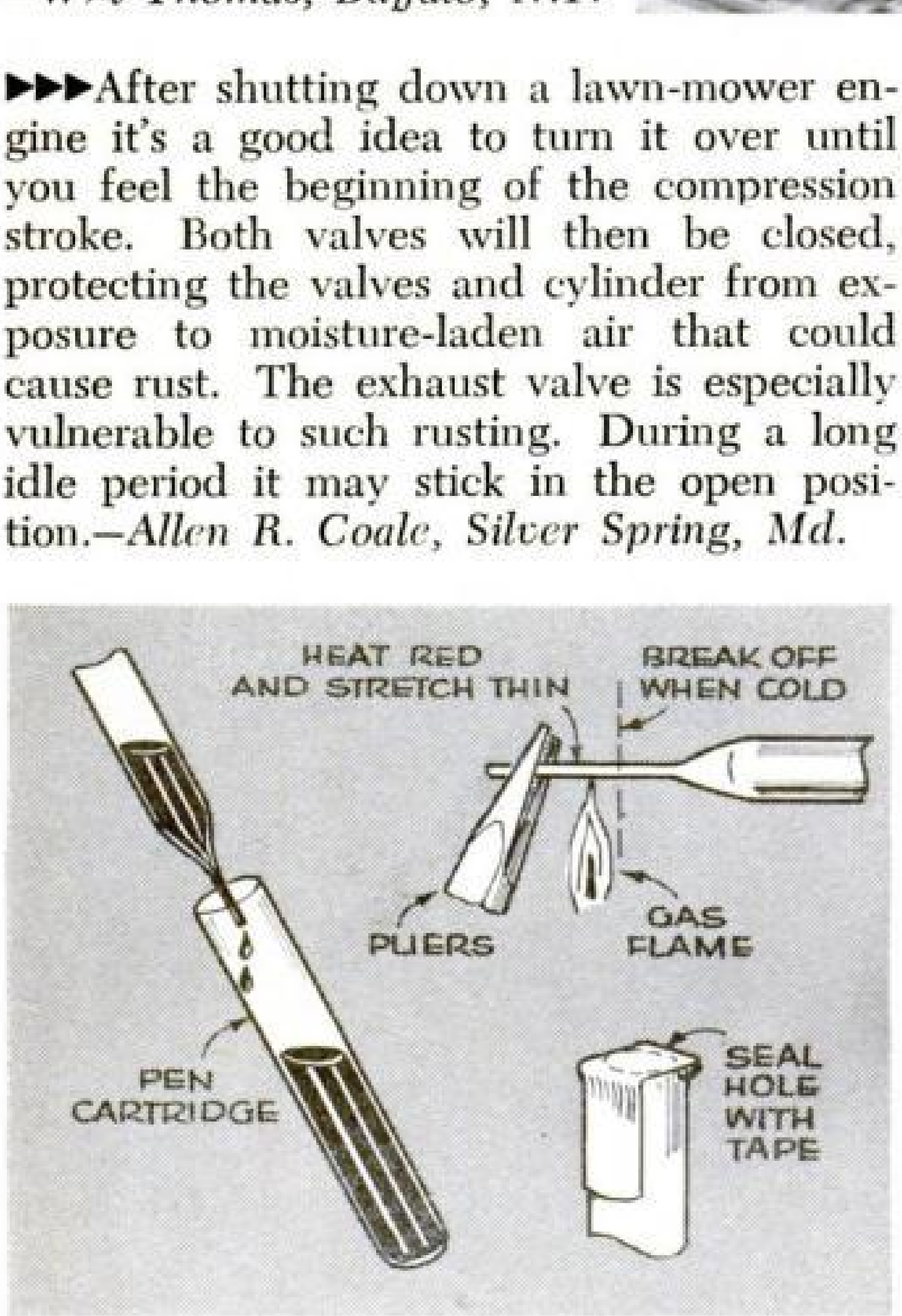
How to grind a point on a metal rod



Chuck a metal rod in a hand drill, rotate its end against a turning grinding wheel, and you'll grind a point on the rod in no time at all. The point can be as blunt or as sharp as you wish, depending on the angle at which you hold the rod against the wheel. If the tip becomes red, dip it in water. —*Will Thomas, Buffalo, N.Y.*

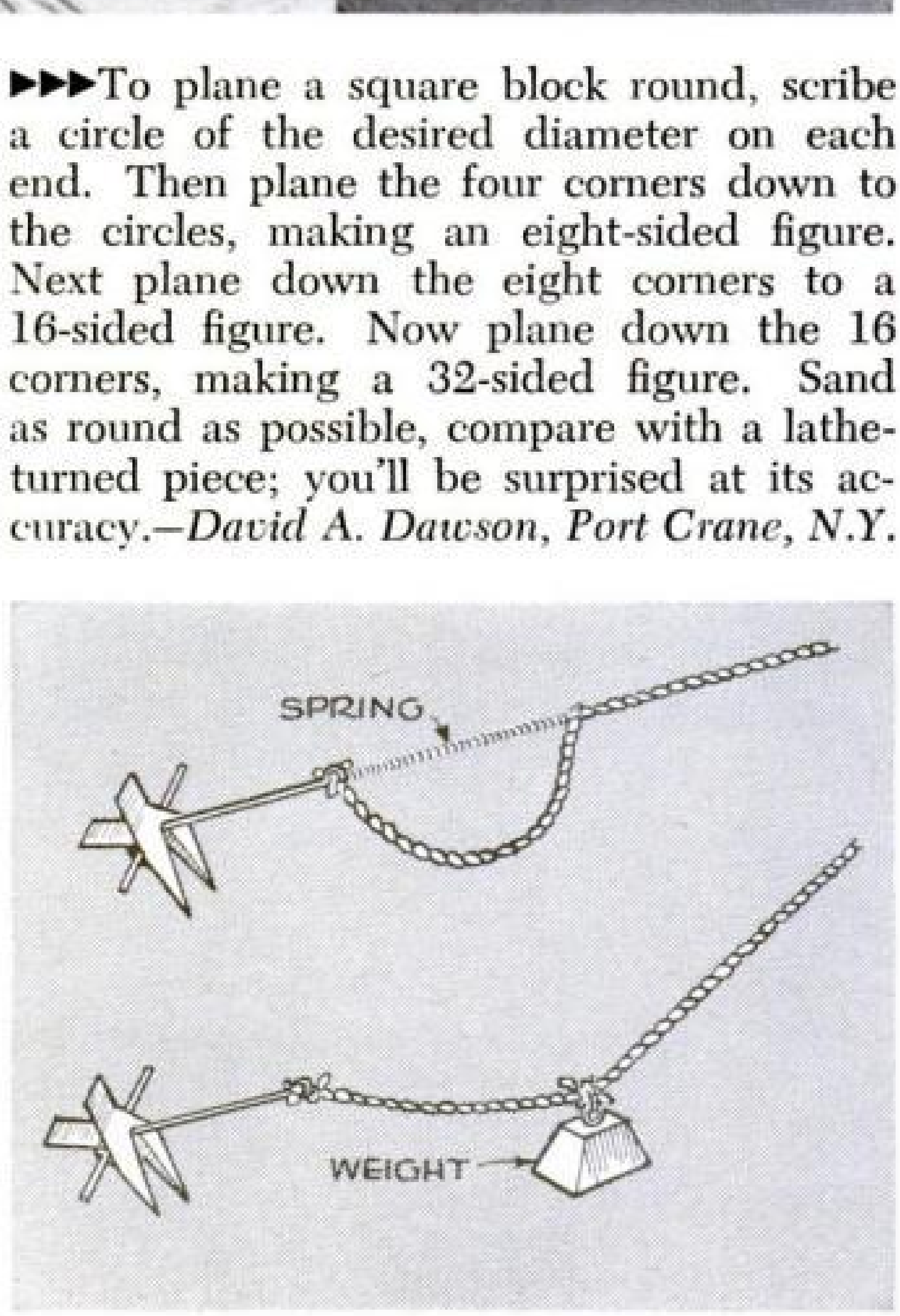
▶▶▶After shutting down a lawn-mower engine it's a good idea to turn it over until you feel the beginning of the compression stroke. Both valves will then be closed, protecting the valves and cylinder from exposure to moisture-laden air that could cause rust. The exhaust valve is especially vulnerable to such rusting. During a long idle period it may stick in the open position.—*Allen R. Coale, Silver Spring, Md.*

▶▶▶To plane a square block round, scribe a circle of the desired diameter on each end. Then plane the four corners down to the circles, making an eight-sided figure. Next plane down the eight corners to a 16-sided figure. Now plane down the 16 corners, making a 32-sided figure. Sand as round as possible, compare with a lathe-turned piece; you'll be surprised at its accuracy.—*David A. Dawson, Port Crane, N.Y.*



Refill ink cartridges to save money

Fountain-pen ink is cheaper by the bottle. If a favorite pen uses up cartridges fast, why not refill them? Get a fine eye dropper, or draw out an ordinary one to a fine tip as shown above. Draw ink into the dropper and fill each cartridge through the hole at one end. Seal spares with cellulose tape. Replace cartridges in the pen with the hole toward the nib, removing the tape first.—*S. L. Walton, White Plains, N.Y.*



Shock absorbers for a boat anchor

Attached as shown in the upper sketch, a heavy spring will serve as a shock absorber for an anchor line in rough weather. Another good way to get shock-absorber action is to attach a weight several feet above the anchor as indicated in the lower sketch. The weight rises when the boat pulls on the line, settles back when the pressure lessens, taking a lot of pull off the anchor.—*John L. Sellers, Nashville, Tenn.*

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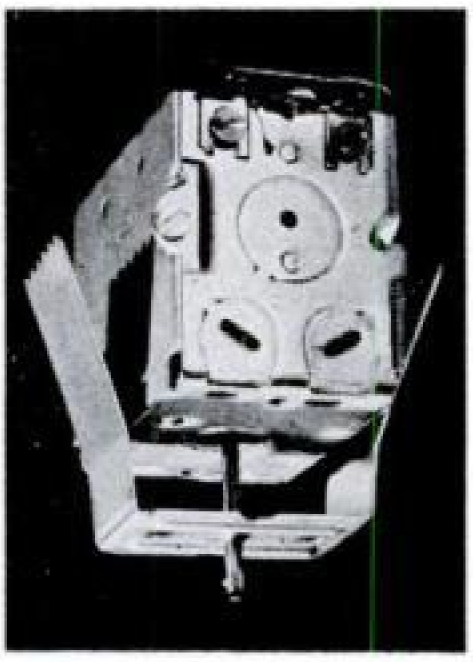
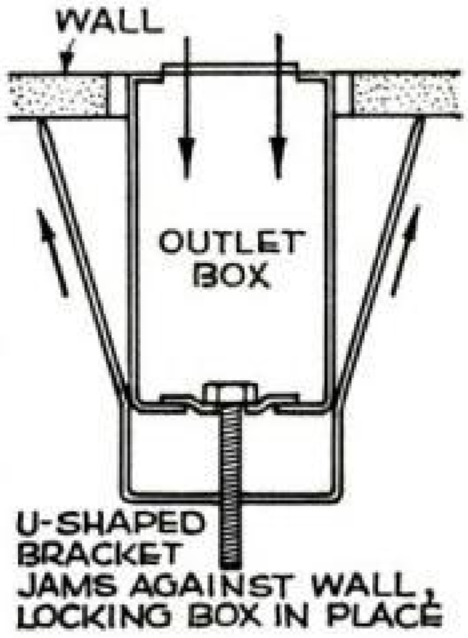
SHOP TALK By Sheldon M. Gallager

Want an easy-to-mount outlet box? Here's a nifty

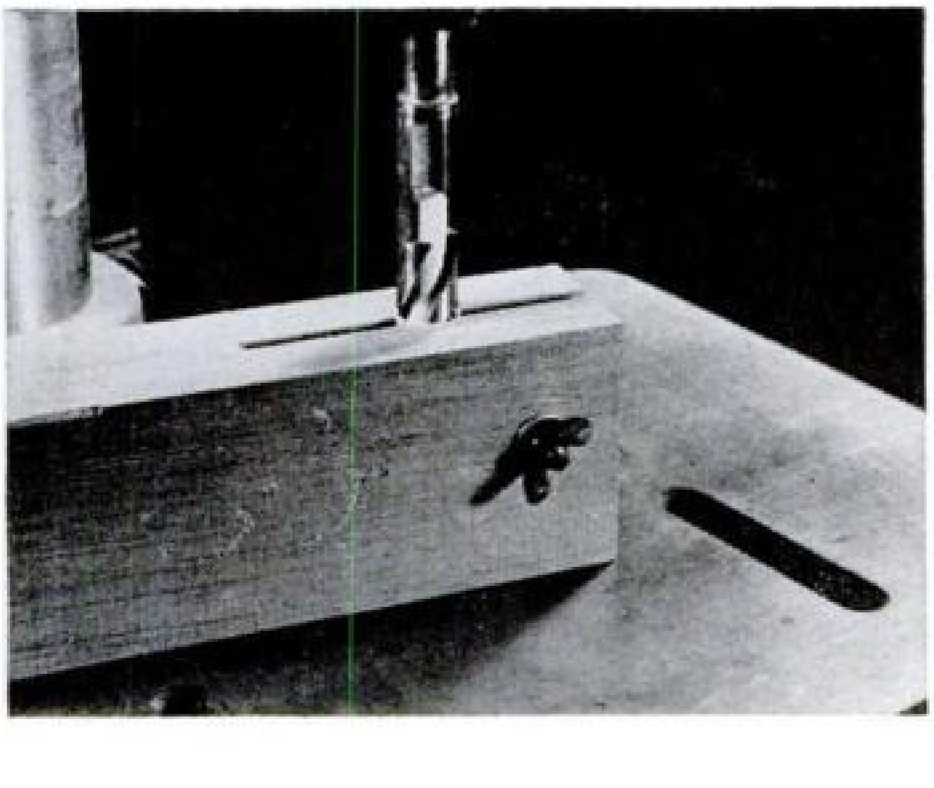




I was rummaging around an electrical-supply store the other day and stumbled on a type of outlet box I didn't know existed. It's a perfect solution to the old problem of mounting a wall box between two studs where there's nothing to fasten it to. There's a U-shaped bracket held to the back of the box with a bolt. You push the box through a hole in the wall, tighten the bolt, and the legs of the U spread out and wedge the box tightly in place from behind, as shown at left. The box is made by Raco, a well-known name in wiring supplies, and ought to be available at most electrical-supply stores. Sears, Roebuck and Monty Ward also sell a box that works in a similar way, I discovered. It has a telescoping ear on each side that squeezes up against the back of the wall as you tighten a bolt. Handy, huh?

Now: A flux for problem soldering jobs

Harry Walton, a familiar contributor to PS, reports he's found a flux, called Duzall, that does an amazing job on hard-to-solder metals like stainless steel, chrome, monel, cast iron, and nickel silver. To prove it, he soldered a screw to a piece of tough clock-spring steel, as at left, and swears you can't break it off. The flux can be used with any kind of solder, requires no laborious pre-cleaning. It's made by All-State Welding Alloys in White Plains, N. Y., but is not available directly from the company. It's stocked by All-State distributors, welding-supply houses, and appliance-repair shops.



A slick trick for tenoning a dowel

R. J. De Cristoforo, another familiar name to PS readers, passes on this tip for putting perfect tenons on the ends of dowels—normally, a tricky job. Do it with a plug cutter in a drill press, as at left. To hold the dowel securely, make a jig like the one shown. Drill a hole for the dowel in a two-by-four block, then saw a slot through the hole and use a bolt and wingnut to clamp the dowel between the two slotted halves. Long dowels can be tenoned by swinging the drill-press table to one side so the jig overhangs the edge.

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It pays to know The Best

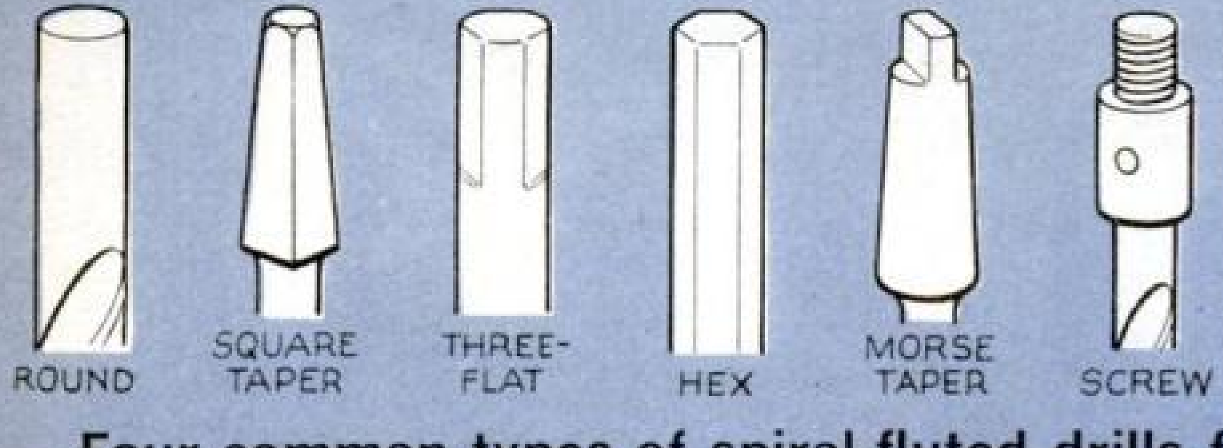
By Harry Walton

IF YOU'RE using twist drills for boring holes in wood, you're getting a third-class job for a first-class price. Twist drills are all right for small holes, but in larger sizes their cost goes up sharply and their efficiency goes down. This is because they are designed primarily for metal, not wood. They don't cut as cleanly across wood grain as they should, and their blunt points tend to wander off course when they hit variations in fiber density and grain pattern. Their steep flutes clog easily and lead to overheating.

There are bits made specially for boring wood that do the job better and, size for size, actually cost less. They have long, slim points that act as pilot guides to keep them from straying, and they're designed to shear the wood grain at their outer edges to give neat, clean holes. For holes above ¼" diameter in wood, they're your best choice.

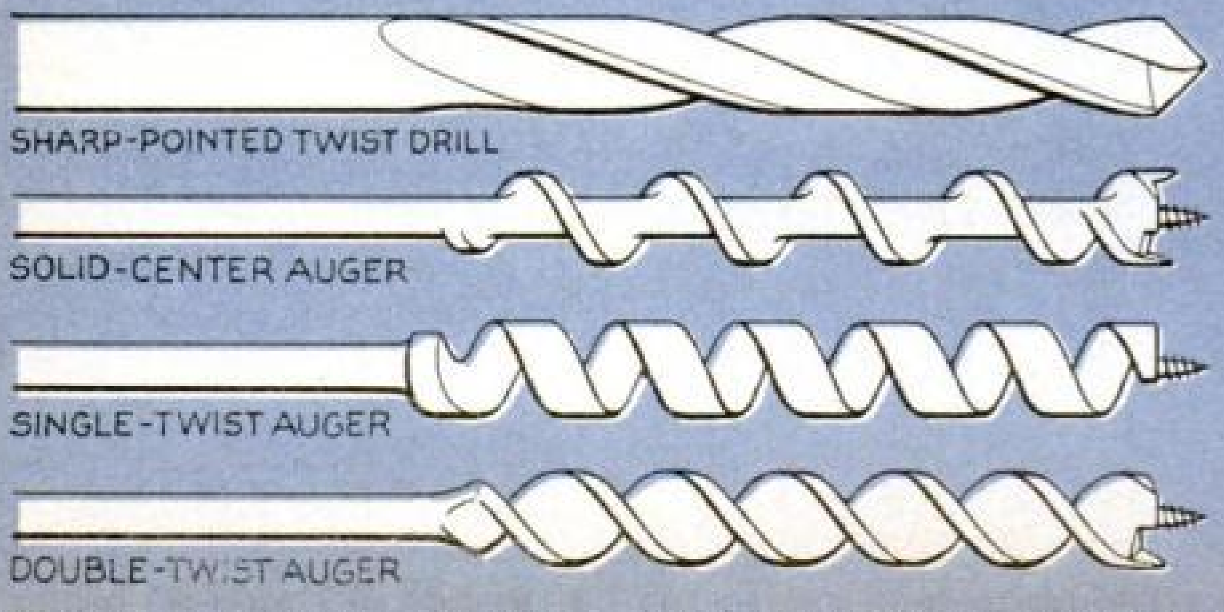
Flat-head bits. The most common wood

Wood bits come in shank styles to fit many drilling tools



Round shanks fit standard drill chucks. The square taper is for a hand brace only. Shanks with three flats fit more tightly in a chuck than plain round ones. Hex will fit both a chuck and, in a pinch, a hand brace. Taper and screw shanks are usually for industrial machines.

Four common types of spiral-fluted drills for wood



Sharp-pointed twist drill at left is the one exception to the rule against using twist drills in wood. Sharper than regular twist drills, it's made specially for boring end grain in wood. Other bits shown are common styles of auger bits for use in a hand brace only.

Bits for Boring Wood

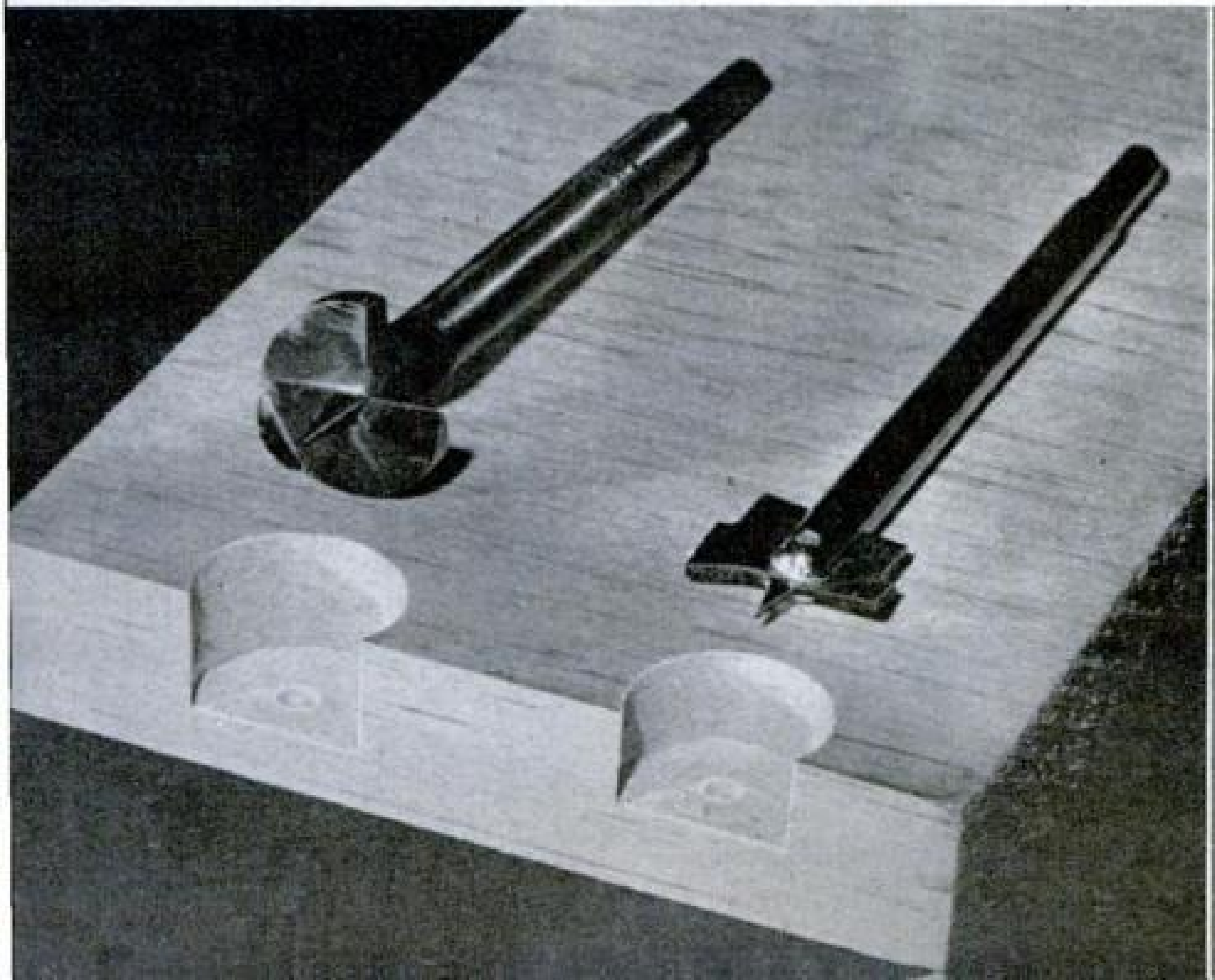
bits, these are known as spade or zip bits. They have long, sharp points to keep them centered while the whirling flat part chisels out the wood. Because the thin blades have no spurs, they don't cut as smoothly as some more expensive wood bits. But they're adequate for most jobs, inexpensive, and a cinch to resharpen because of their simple design.

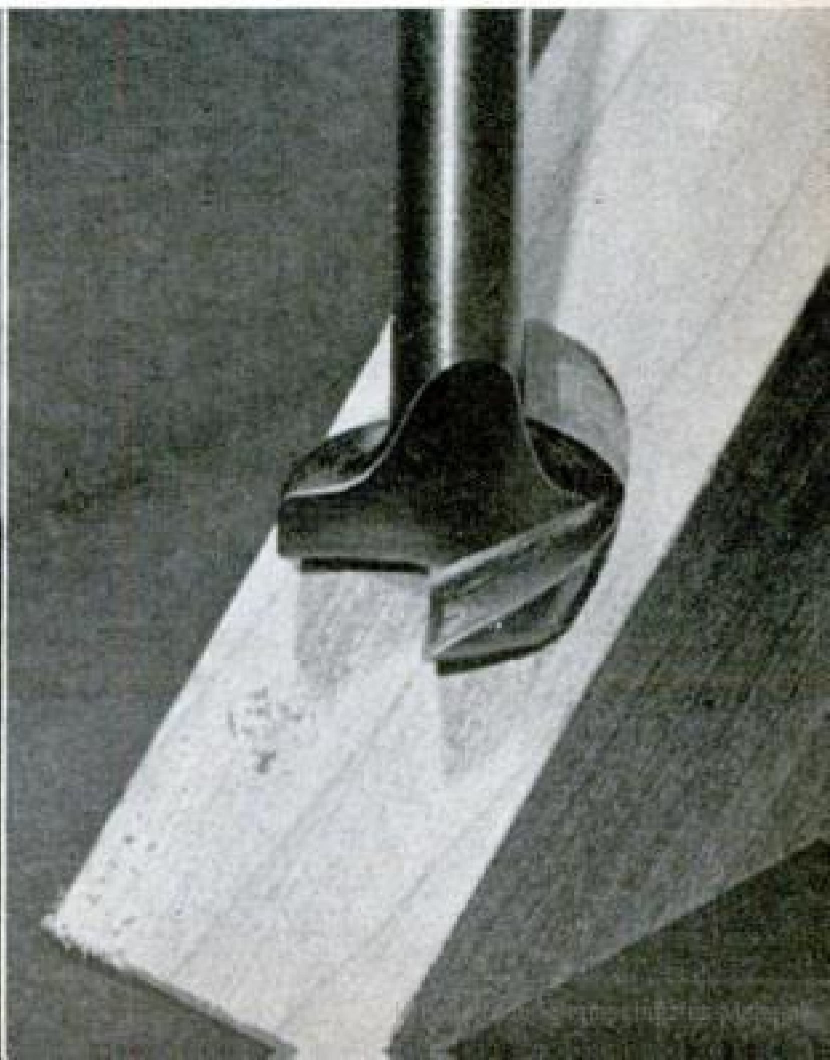
Better-quality spade bits have downward-curving points at their outer tips. While these are not true spurs, they shear the wood fibers at the rim of a cut before the main part of the bit makes contact, helping

CONTINUED

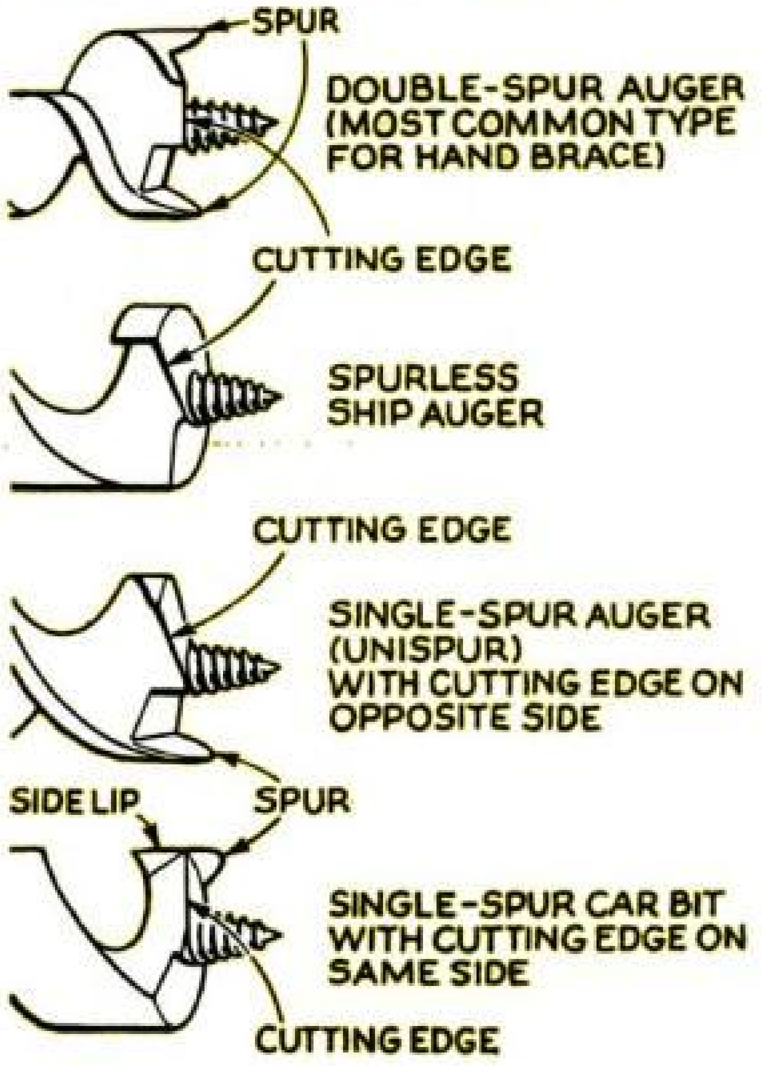
Big-hole bits have self-feeding screw points, as at right, to help draw them into the wood. The outer spur shears the wood, while an inner cutter scoops out chips. This type of bit cuts a full hole, not just a circle. It requires plenty of power, is best used in a drill press or slow-feeding hand brace. Stanley and Skil make similar styles in sizes up to 2 9/16".

You can't bore holes like these with ordinary twist drills—they'd slip right off the edge. But these two special wood bits have long points to keep them centered—important in uneven wood grain. They'll even drill angled holes without slipping, as at right. Round type is Stanley's Power Bore design. Flat spade type costs a bit less. Both are good.





Four different auger points

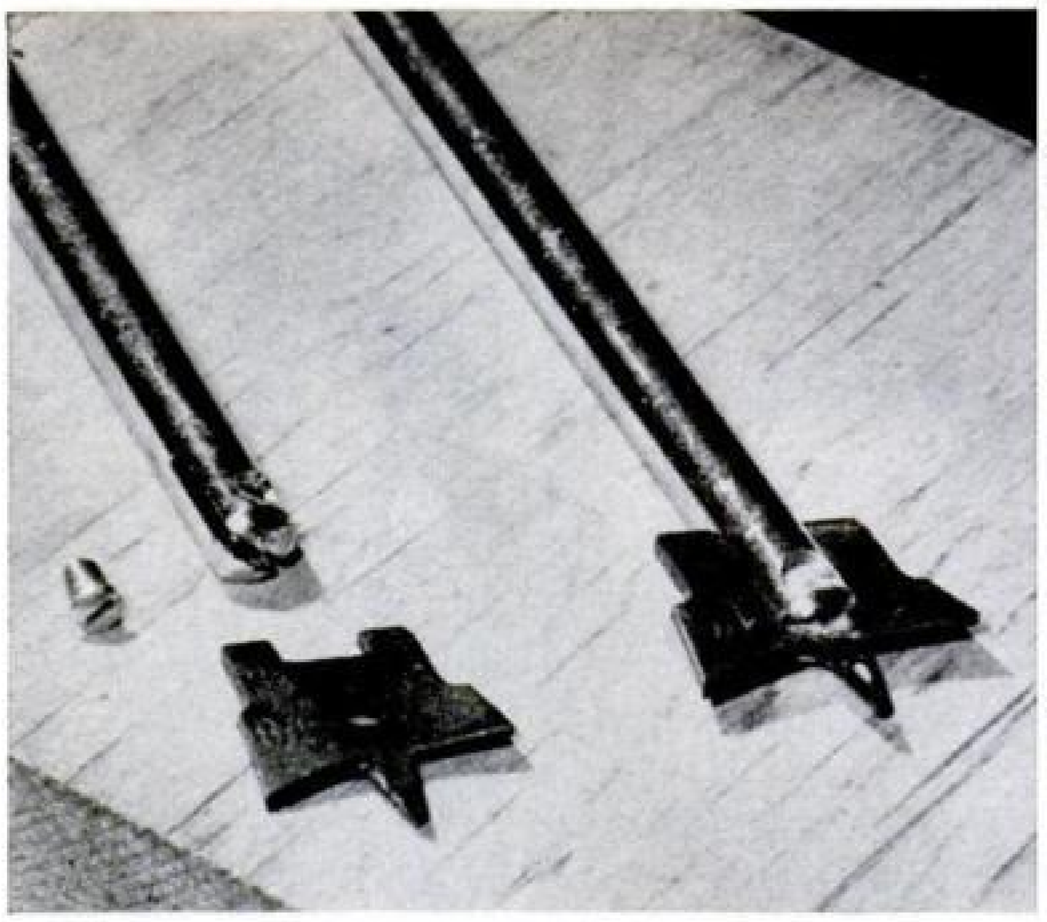


to produce a clean-edged hole. Some low-cost spade bits, especially those of older design, have straight-edged blades that don't cut as smoothly.

Spade bits range in size from ¼" to about 1¼". Some are one-piece affairs with fixed blades, while others have replaceable blades. In some cases, you buy only one shank with a series of cutting heads of different sizes. Sears, Roebuck sells a set of nine cutters and a shank for only $3. Here, you get good economy, but with the slight inconvenience of having to switch cutters every time you change to a new hole size.

One interesting development in spade bits is Stanley's new high-speed-steel version. Much tougher than the ordinary spade bit, it will hold its temper when heated by high-speed boring and will chew through nails or screws that might be in wood.

New round bits, too. Power Bore bits, also sold by Stanley, look something like a cross between a spade bit and the old-fashioned auger bit. There's a small head on a long, thin shank, like a spade, but the head is round instead of flat. At the rim of the head is a spur—a downward-pointed blade that outlines the hole and shears the wood ahead of the main part of the blade. It's this spur that enables the bit to cut



Newer spade bits often have removable cutting heads, easily replaced when worn. Heads are locked into a slot with a small screw. Such bits are sold by Skil, B&D, Sears, and others.

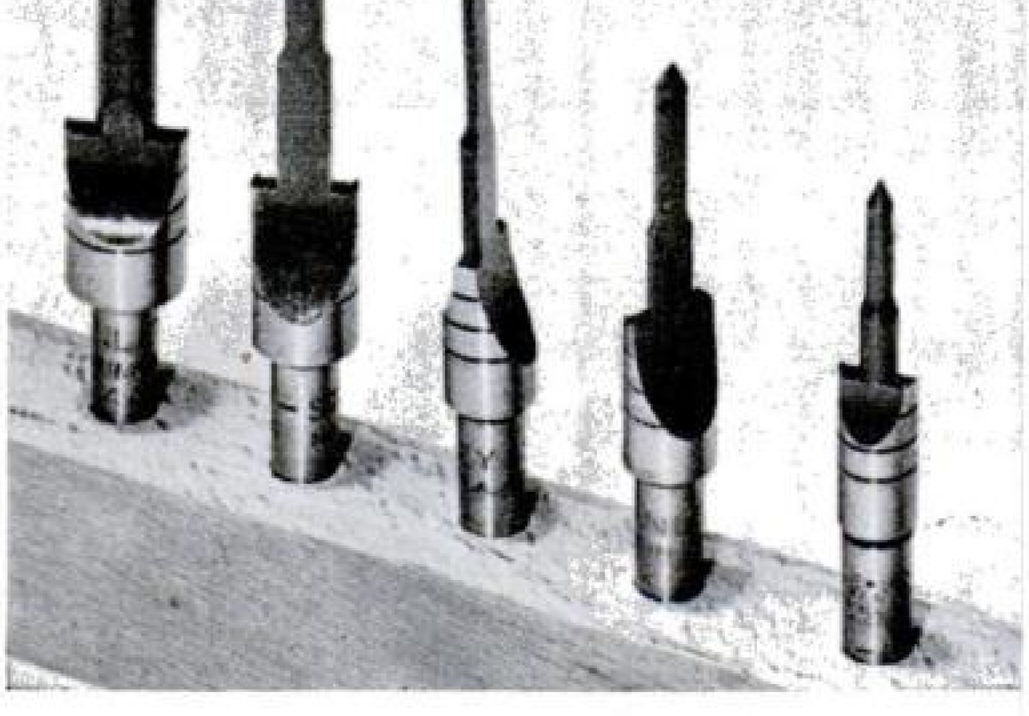
cleanly and smoothly, even in easily splintered plywood. Power Bore bits come in sizes from ⅜" to 1" in ⅛" steps.

Forstner bits, an older style, have a continuous circular spur and a short point. Best used in a drill press, they bore slowly but make clean, straight holes.

Large-hole bits. For holes above 1¼", they're usually called hole cutters or hole saws, rather than drills. There are two

Combination screw-hole bits

Triple-threat bits for screws drill the pilot hole, clearance hole, and countersink recess all at one time. The fixed type, shown below, is sold by Stanley in



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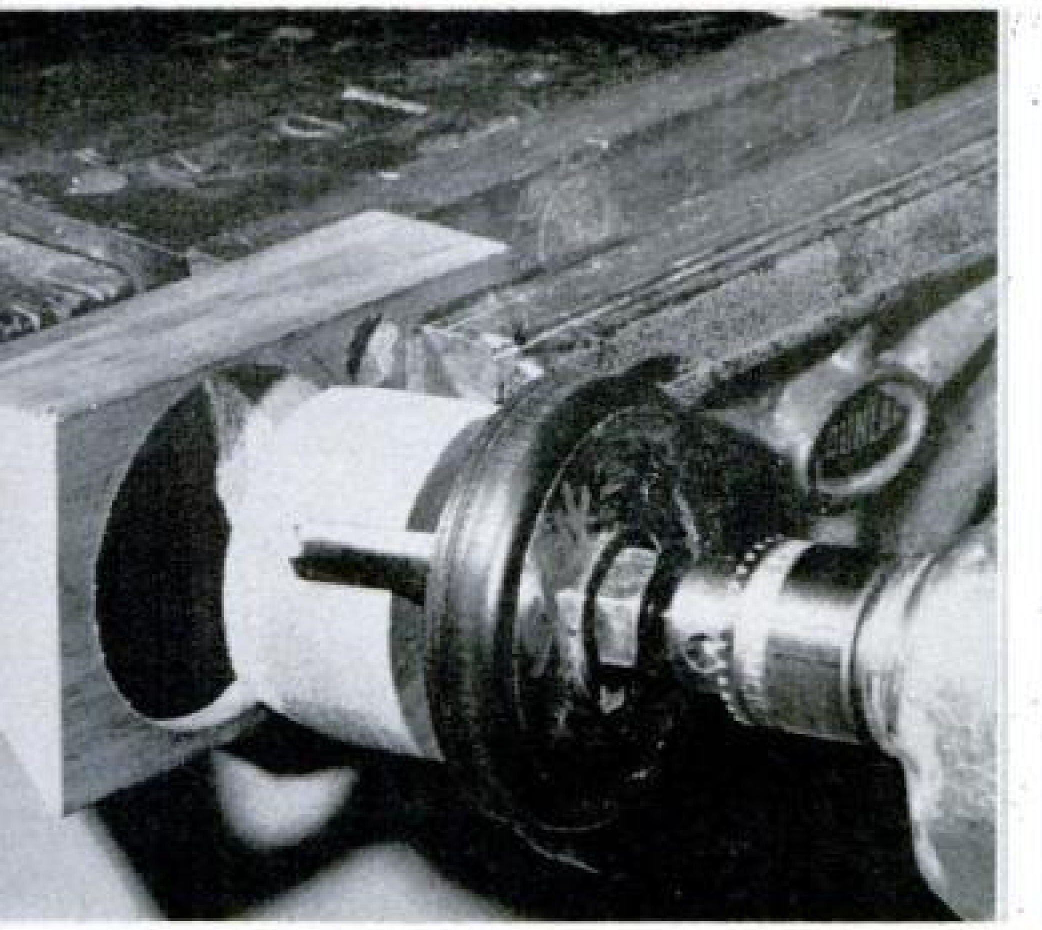
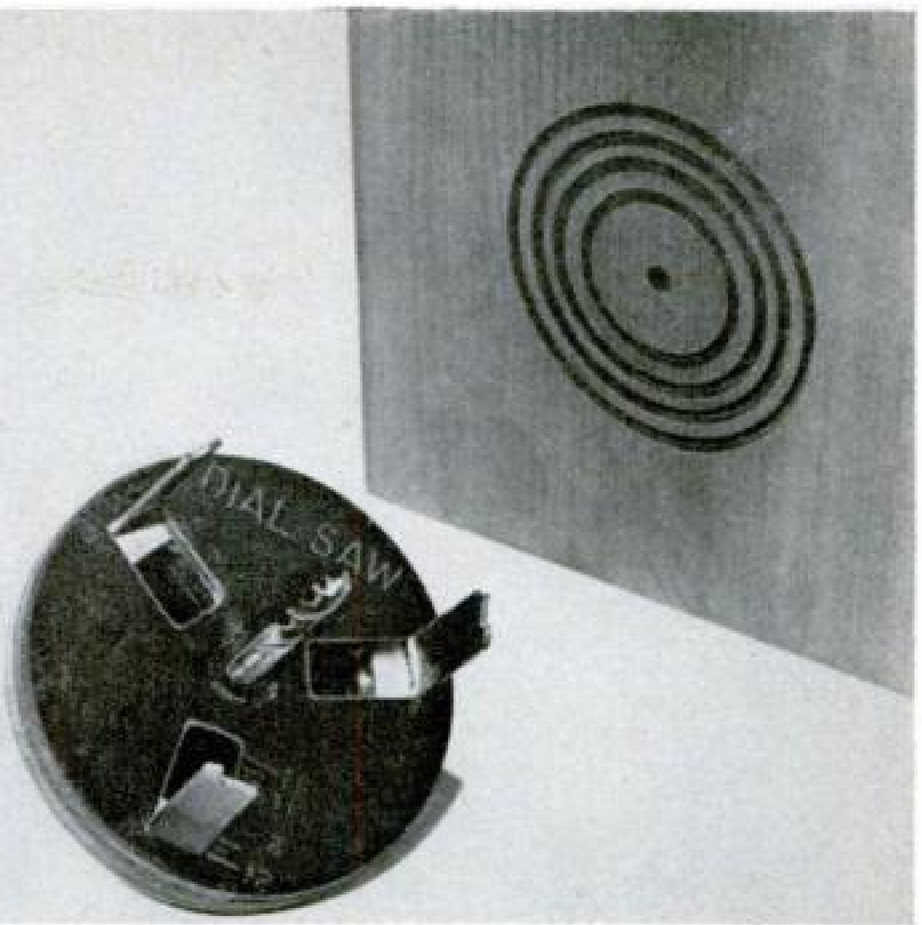




An adjustable circle cutter, this one can be set to make any size hole from 1⅛" to 2 7/16" by twisting its head. Its three cutters ride in spiral grooves and are moved closer together or farther apart to vary the size hole they make. Called the Skil Dial Saw, it cuts stock more than 1" thick from one side, or more than 2" thick if you drill from opposite sides.

basic types—those that cut away all of the wood in the hole and those that simply cut out a circle of wood, leaving a hole.

Solid-center bits that cut out the entire hole require a lot of power. They have self-feeding screw points that are designed to pull them into the wood. This is a useful feature provided you have enough power, but it makes heavy going for all but the huskiest ⅜" and larger electric drills.

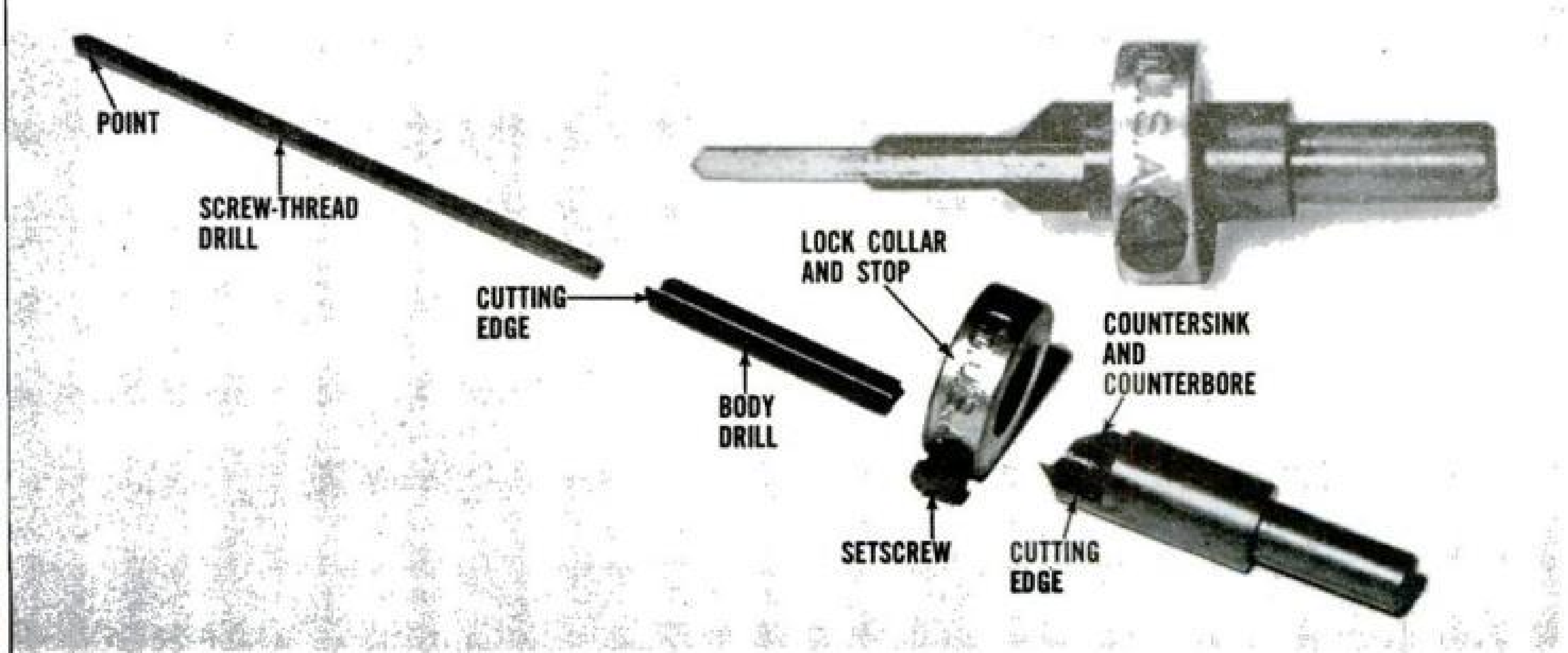
This type of bit is best used in a drill press. It can also be used in a hand brace where the slow feed doesn't cause the screw point to grab. Stanley makes it in three sizes (1¾", 2", and 2⅛") and Skil makes it in seven (from 1¼" to 2 9/16").

Circle-cutting hole saws. These need much less power than solid-center bits and are a better choice for use in an electric

[Continued on page 202]

can do the whole job for you in one quick pass

sizes to match the most popular screws used —one bit for each length and diameter of screw. An adjustable version shown below, has sliding cutters that can be varied to suit different screw lengths—you buy only one bit for each screw-diameter number. Made by Millers Falls, it has an adjustable depth-stop collar that can be shifted for counterboring as well as countersinking. Accessory stop collars are also available for the Stanley bits. Another type of bit has a fixed-stop collar that permits countersinking but not counterboring.



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Adequate heat is a must. Here, a small hand torch gets an assist from a kitchen gas stove. The trick, helpful on large or thick joints, keeps the torch's heat from dissipating away.

The Secrets of GOOD

Stronger than soldering, easier than welding, it's the tool for making fine joints in metal

By Thomas Moore

BRAZING, unlike soft soldering, actually sticks one metal to another without bolts, rivets, or other fastenings. The joints it produces are often stronger than the original metals. They're easy to make and neat-looking.

Because of this, brazing can be an important shop tool. It combines neatness with strength, making it ideal for intricate fittings, boat or other hardware, fine jewelry. Even hefty structures like playground equipment and bike, kart, and trailer frames aren't too big for brazing.

Brazing is no more difficult than soldering, but, like soldering, it has its rules. The secrets of good brazing are merely a matter of following these rules carefully.

The terms brazing, hard soldering, silver soldering, and silver brazing all apply to the same general process—joining two pieces of metal by fusing a filler metal, called spelter, into the joint at a temperature near the melting point of the metals. This requires a much higher heat than soldering and, because the metals are actually fused, produces a stronger joint. Also, it is simpler and less costly than welding.

Which metals for what jobs? There are many filler metals used in brazing. Their choice depends on the type of metals be-

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What brazing can do for you: This matched set of gleaming, modern sailboat hardware—costing you $30 or more if bought commercially—was brazed up from about $3 worth of scrap brass.

BRAZING

ing joined, their relative melting points, and the color and appearance desired.

Generally, ordinary carbon steels are brazed with manganese-bronze rod in conjunction with borax-type fluxes. Iron castings can be repaired with manganese-bronze rod, but with a cuprous (copper) oxide flux. In brazing copper, brass, and bronze, silver brazing alloys are used along with borax-type fluxes. Silver and gold are also brazed with silver brazing alloys. Aluminum, on the other hand, requires a brazing rod with a very high aluminum content in order for the filler to be compatible.

The accompanying chart lists some popular brazing metals and fluxes by brand name and shows which ones to use according to the job. Brazing metals are usually sold by the pound in rod form for brass, bronze,

Common types of brazing joints

A strong joint depends on good contact between the two mating parts. The greater this contact area, the stronger the bond. This is why most of the typical joints shown above have their parts lapped over each other in some way instead of simply butted together.

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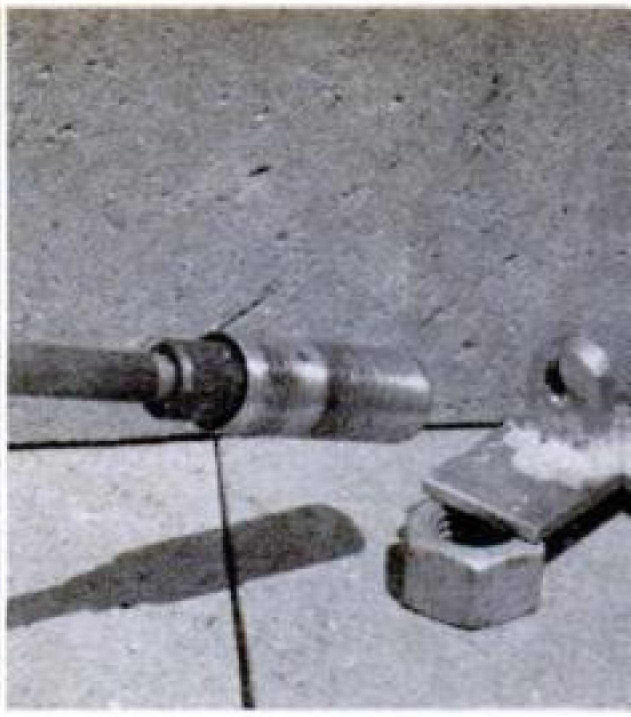


Five easy—but important—steps to a well-brazed joint

1. Clean the parts thoroughly with abrasive paper, a file, or a grinding wheel. Surfaces must be shiny bright and free from all grease, dirt, and tarnish or the braze will not take.

2. Choose the right flux for the type of metals being joined and brush it liberally on the mating surfaces. The flux should be as fresh as possible. Don't use any stuff that's real old.

3. Apply heat slowly at first, painting the work with the flame like a brush. Water in the flux must be boiled out gently before the work can be brought up to full brazing temperature.

and aluminum and in wire form for silver alloys. For convenience, some companies make a flux-coated brazing rod that eliminates the need for a separate flux.

The three basic secrets. No matter what metals you join, the technique is the same. The first rule for good brazing is adequate heat. You need a torch with a flame temperature of at least 1,800 degrees F. This, however, is only the bare minimum required. The size of the joint and the type of metals being joined will determine the kind of torch you'll need.

A tiny alcohol lamp with a blowpipe can supply a usable flame temperature, but it will be limited to very small joint areas, such as in making jewelry. For average shop work and home fix-it jobs, the familiar little hand-held propane torch is adequate, inexpensive, and convenient.

Cleanliness is the second rule—the joint must be absolutely clean both physically and chemically for the braze to take. It's the flux's job to clean the metal chemically, but the joint must also be scraped clean first. Do this by filing, grinding, or sanding the mating surfaces until they are bright. If you use the type of brazing rod that contains its own flux, the need for thorough cleaning is especially important.

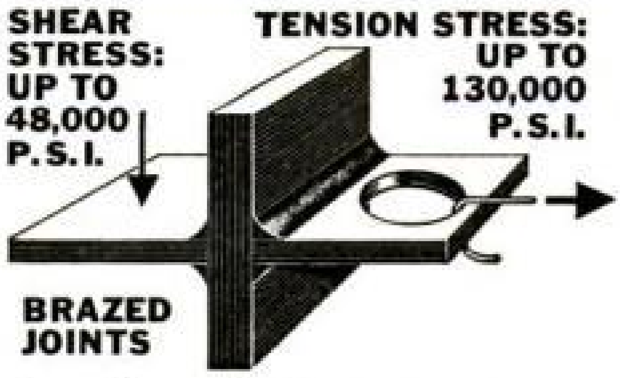
The third rule is a good fit between the parts. Brazing cannot cover up poor workmanship. Braze metals, unlike solder, are thin and watery. It's this characteristic that enables them to make fine, hairline, almost invisible joints. But, at the same time, it means you can't rely on them to fill up holes and gaps. The parts must fit together closely to start with.

A close-fitting joint is also needed to draw the thin braze metal into it by capillary action. This is important in stainless steel, which needs tighter joints than brass, copper, silver, or aluminum. A butt joint in stainless with a gap of .002" will withstand more than 130,000 pounds-a-square-inch pull in tension. But open the gap to .024" and this tensile strength drops to only 40,000 p.s.i.

How you do it. Once the parts have been cleaned, coat the surfaces with flux. If the pieces won't stay together by themselves, use iron wire, clamps, or weights to hold them. Handle them with gloves or tweezers, not your bare hands, as oil from your skin may contaminate the joint.

Adjust the torch flame

How strong is a brazed joint?



Any brazed joint is stronger when pulled than when bent. But it's tough both ways. A well-brazed joint can take up to 130,000 pounds per sq. in. in tension, 48,000 p.s.i. in shear.

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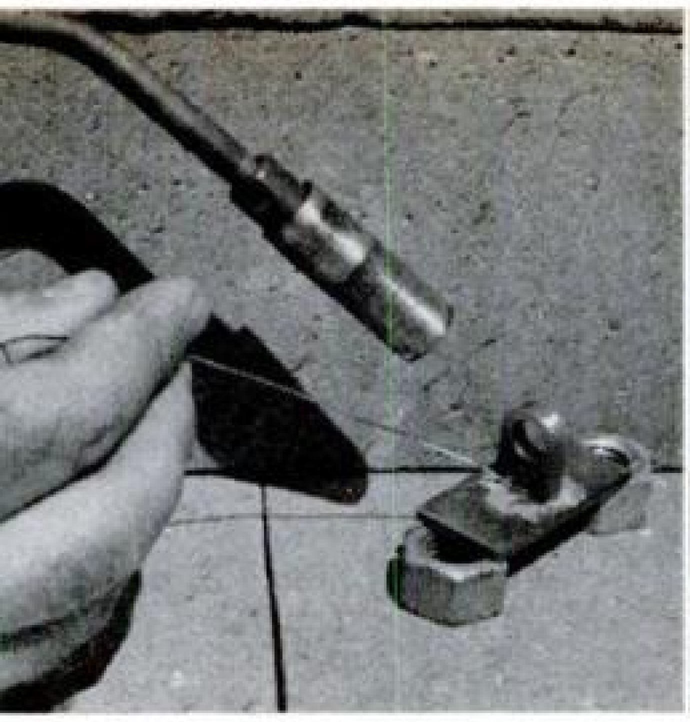
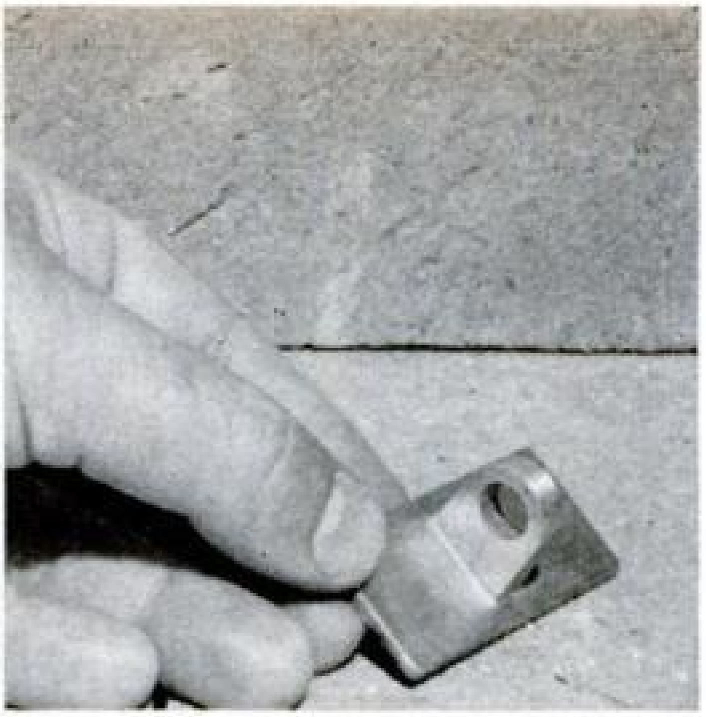


4. **When flux has melted** and glazed, bring the work to pink-white heat with direct flame. At this point, feed the braze rod into the joint until all cracks are filled with molten metal. Keep the flame on the work but away from the rod.



5. **Scrape off the hard scale** left by the flux after the work has been cooled in water. Use steel wool, a fine file, or abrasive paper. Then polish the work to a high sheen. Note above how the braze produces a beautifully fine, smooth, almost invisible joint between the parts.

How to choose the right braze alloys and fluxes

JOINT METAL	BRAZE-METAL ALLOY (BY BRAND NAME)	MAIN BRAZE-ALLOY ELEMENTS (BY PERCENT)	BRAZE-METAL FLOW TEMP. (°F.)	FLUXES (BY BRAND NAME)
STAINLESS STEEL	BT	Silver 72 Copper 28	1,435	Handy
STAINLESS STEEL 430	630	Silver 63 Copper 28	1,475	Handy
BRASS	Easy Flo	Silver 50 Cadmium 15 Zinc 16.5	1,175	Amberine, Handy, or Borax Sodium Carb.
COPPER	Easy Flo or Sil-Fos	Silver 15 Copper 60 Zinc 21	1,300	Amberine, Handy, or Borax Sodium Carb.
GOLD	Extra Easy No. 2460	Gold 67 Copper 22 Silver 11	1,290	Borax (reg.), Amberine, or Water and Handy 1:1
SILVER	Easy Silver Solder	Silver 70 Copper 20 Zinc 10	1,325	Amberine, Borax (reg.), or Handy
ALUMINUM 6061	Alcoa No. 718	Aluminum 85 Silicon 12 Iron .8 Copper .3	1,080-1,110	Alcoa No. 36
CAST ALUMINUM	Alcoa No. 718	Aluminum 85 Silicon 12 Iron .8 Copper .3	1,080-1,110	Alcoa No. 36 or No. 33
CARBON STEEL	Victor No. 1	Copper 64 Zinc 36	1,600	Victor No. 3
CAST IRON	Victor No. 1	Copper 64 Zinc 36	1,600	Victor No. 3

to a blue core. Start heating the joint gradually by sweeping it with the tip of the flame. Allow the water in the flux to boil away gently—too rapid a boiling action will force the joint apart. The flux will first become dry, white, and chalky, and then will melt and glaze. At this point, start holding the flame directly on the joint as the metal begins to glow from red to pink.

When the metal is pink-white, touch the brazing rod to the joint, being careful not to move the parts. Keep the flame away from the rod itself so the braze metal is melted entirely by heat from the joint, not from the torch. Keep feeding the rod until

[Continued on page 200]

Which torch for what jobs?

ALCOHOL 2,100° F.

NATURAL GAS 4,000° F.

Both of these will braze but are limited to small jobs, such as joints in jewelry, models, clocks.

GASOLINE 1,800° F.

Suitable for small home repairs, not too handy.

PROPANE 3,595° F.

Good for small repair and fabrication jobs, making hardware, etc.

ACETYLENE 5,500° F.

For fabrication of moderately heavy structures.

OXYACETYLENE 6,300° F.

For very heavy fabrication of machinery, etc.

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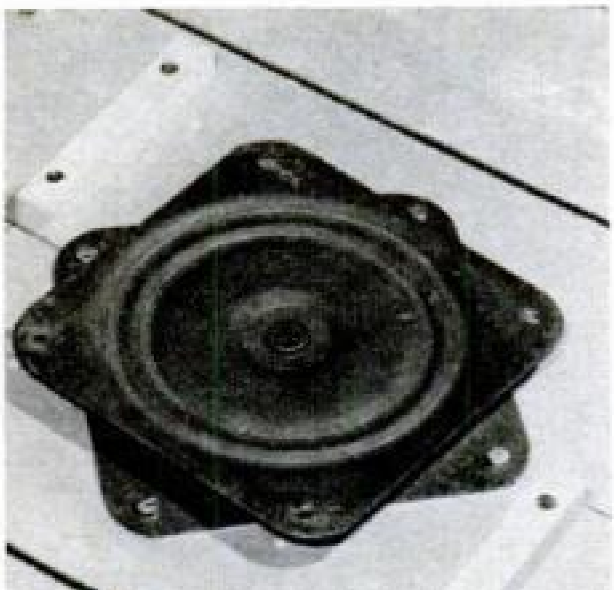
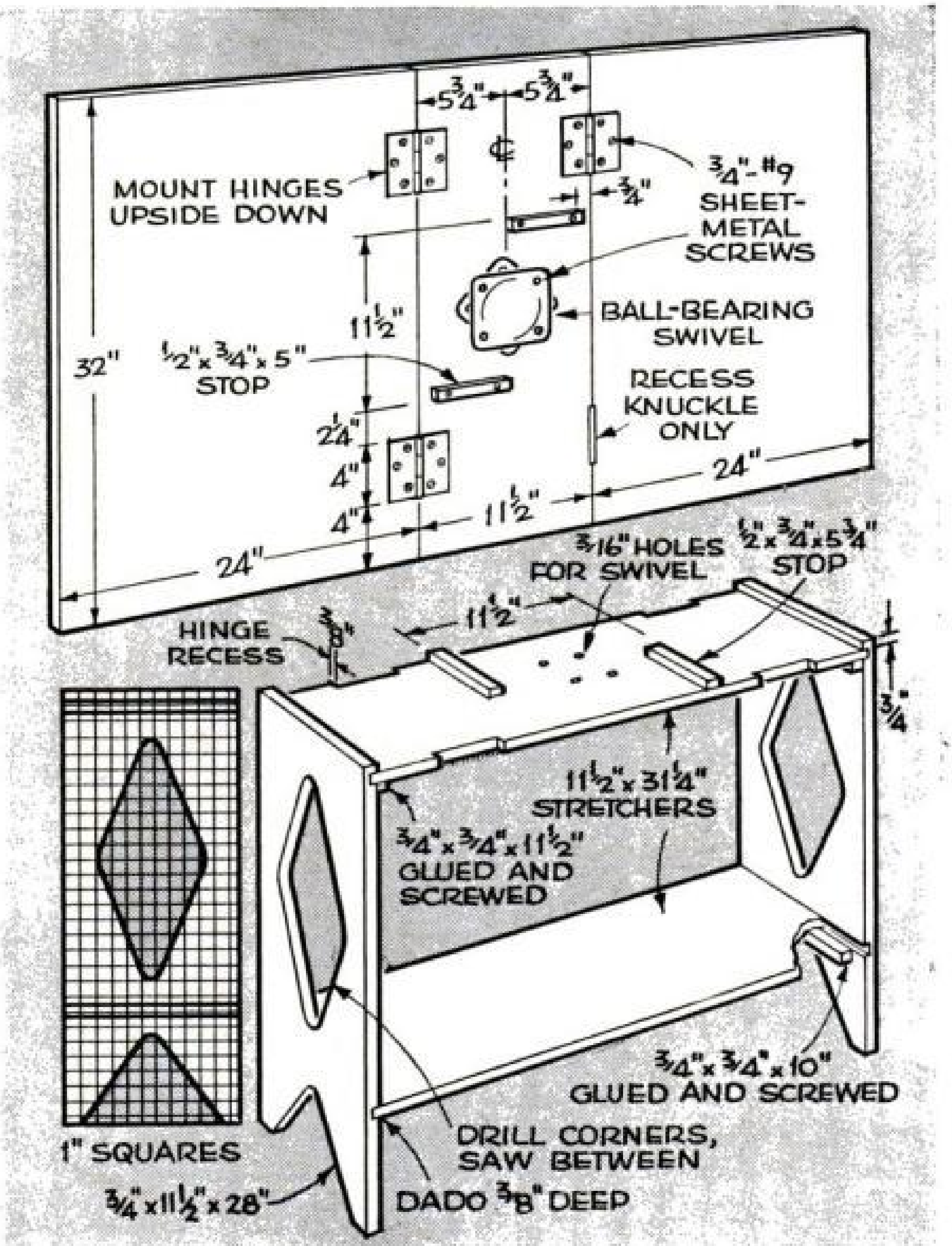
The whole top turns on a ball-bearing swivel, and the two hinged leaves drop to make a compact table between meals.

A Drop-Leaf Table with a New Twist

A DROP-LEAF dining table is always practical because of the space it saves while serving as a small table between meals.

The 6″ or 7″ ball-bearing swivel used on this one will cost you about $1.50. You'll have to be careful to locate and mount the swivel and rotation stops exactly as indicated, but otherwise the table is easy to make. It's best to use veneer hardwood for the leaves, but you can glue up solid wood if you wish.—*J. F. Bogash, NYC.*





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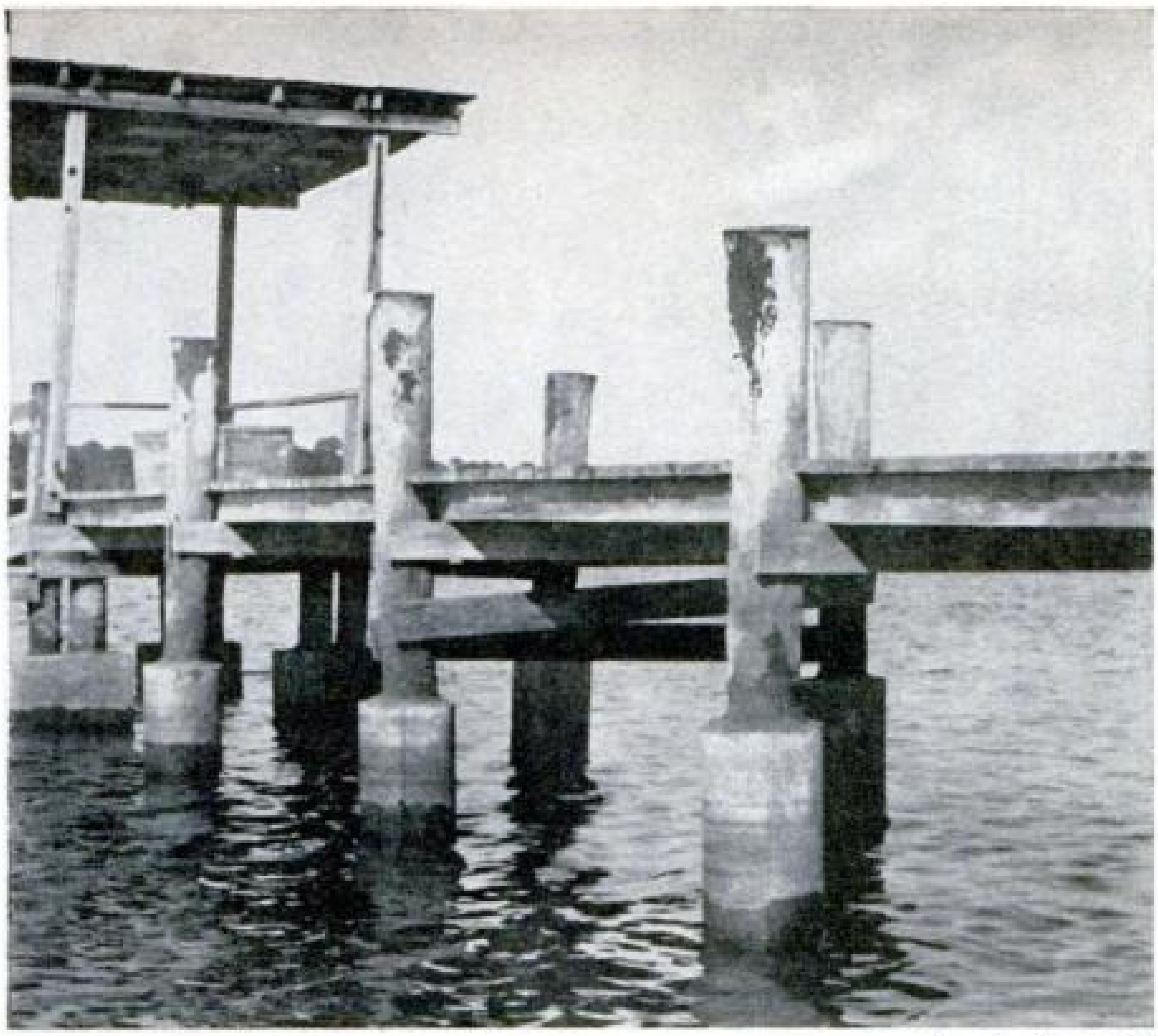
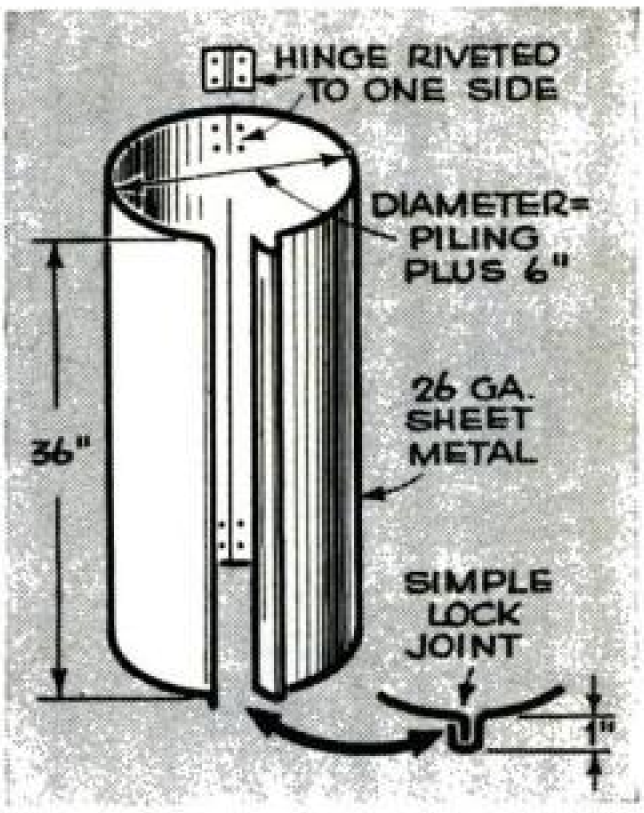
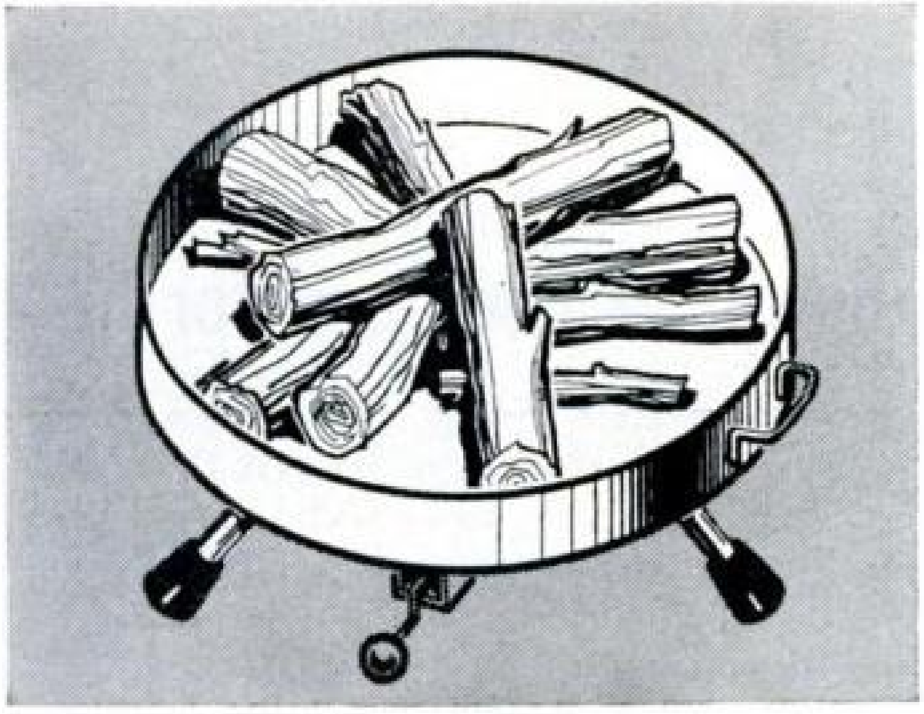




How to cast concrete sleeves on pilings

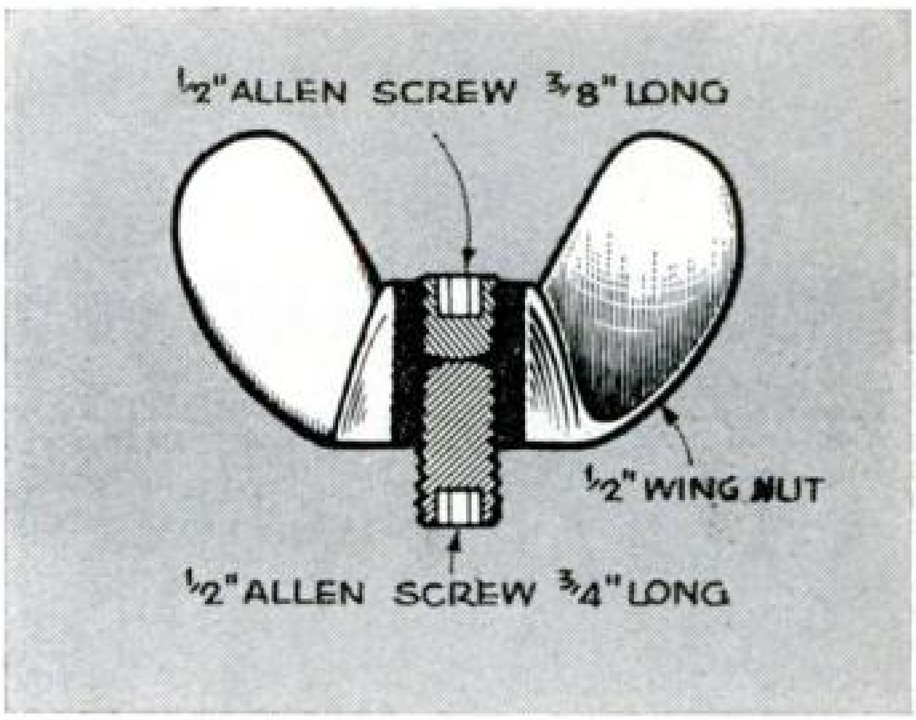
Own a tidewater pier? You can easily protect the wood pilings with concrete sleeves cast in place at low tide. Have a local sheet-metal shop fabricate a form as shown (right). Make sure the diameter is at least 6" more than the largest piling. If you need a form longer than 36", rivet on a section. Use 3 parts gravel, 2 parts sharp sand, and 1 part cement, mixed very dry. You should be able to remove the form in about three hours.—*Keith Vining, New Smyrna Beach, Fla.*



For heat outdoors, cut down a barbecue

Shorten the legs of a portable barbecue to about 8" and you're all set for cool evenings when you'd like to stay a little longer on the patio. Just build a small wood fire in it. It's still okay as a barbecue, too.—*Gene Weiss, Campbell, Calif.*

▶▶▶Cement a rubber jar ring to the base of a small flowerpot, let it dry thoroughly, and you'll have solved an old problem —the unsightly marks that such a pot usually leaves on a windowsill or furniture. —*Mrs. M. Strobel, Union City, N.J.*



How to make a miniature hex wrench

A wing nut and a pair of recessed hex socket screws make a handy miniature hex wrench. Use a wing nut with a ½" threaded opening. Screw in two Allen-type ½" recessed-head screws from opposite sides.—*Henry Mullen, Cleveland.*

▶▶▶I always had trouble cleaning circular-saw blades after cutting through pitch pine. Now I've found an easy way. I use a can of oven cleaner. With the help of steel wool, the blades clean up like new.—*H. E. Richardson, Midland, Mich.*

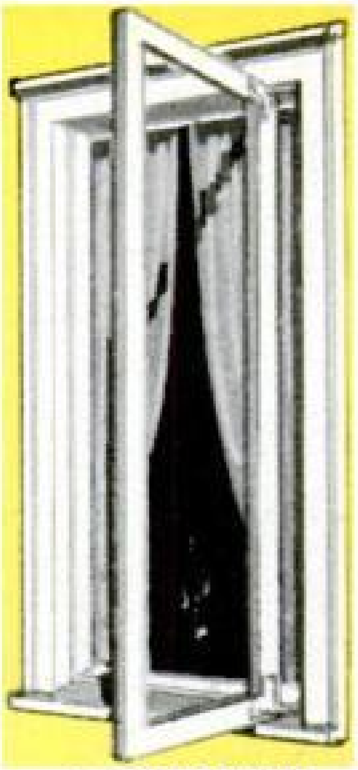
Urheberrechtlich geschütztes Material

PS HOME IMPROVEMENT

Planning to build or remodel?
Here's an architect's advice on

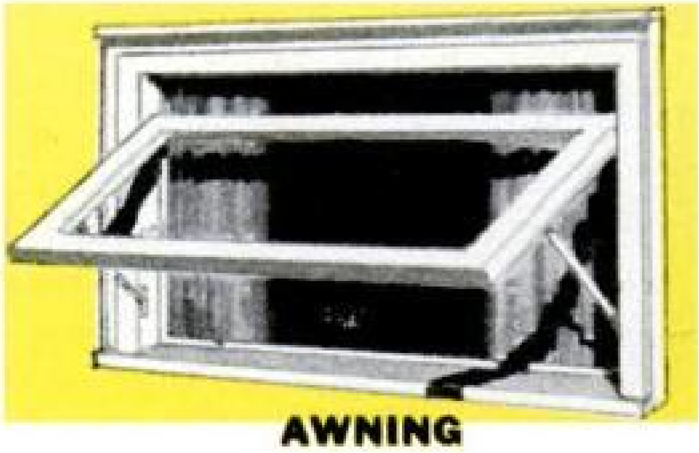
Choosing the Right Windows

DOUBLE-HUNG

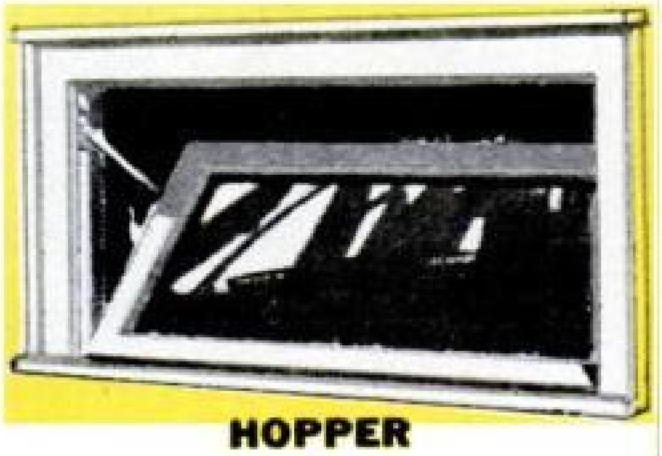


CASEMENT

SLIDING



AWNING



HOPPER

WINDOWS THAT SLIDE: up and down, or back and forth

By G. K. Geerlings, A.I.A.

A premium window used to be one made of kiln-dried lumber. That's now taken for granted. Moreover, you can count on the wood having been toxic-treated to protect it from termites, rot, and absorption of moisture. And, as often as not, the windows you buy have factory-installed weather stripping.

These are some of the plusses you get in stock windows nowadays. You pay more than you used to—but you get more.

Nor do you need to restrict yourself to wood windows. Good windows are also made of aluminum, steel, wood and plastic, and wood and aluminum, and you should consider all of these in making your choice. They're made in all window styles.

In opening action, windows can be divided into two classifications—those that slide, those that swing. In choosing between the two, keep in mind that the maximum clear opening of any sliding type can't be more than 50 percent of the frame opening. In contrast, any hinged type can be 100 percent open.

The type, shape, size, and placement of windows can improve or detract from the exterior appearance of a house. By varying the size and shape of the windows, you can emphasize either horizontal or vertical lines, making the house look longer or higher. If you want small panes for a modified Colonial design, it's wisest to limit your choice to stock windows which have the glass area divided by removable muntins. These make window washing much easier.

The flexibility feasible in combining a number of window units of the same type, or in combining more than one type (as double-hung and stationary), not only pro-

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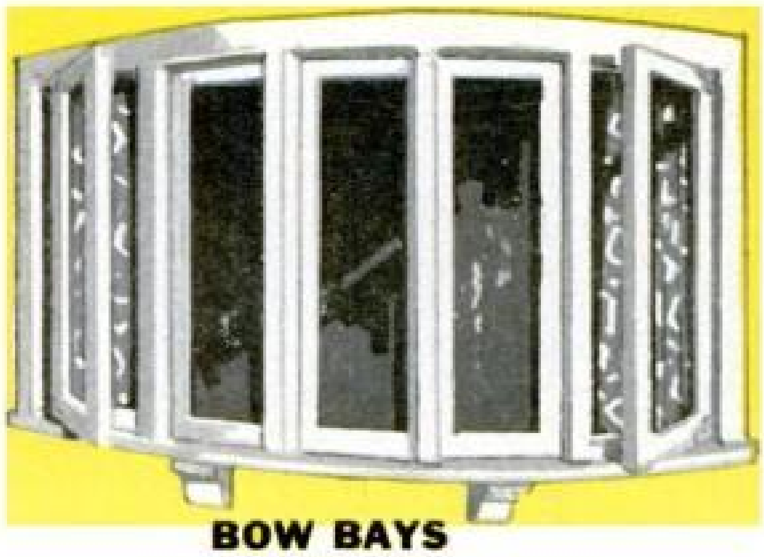
AT-A-GLANCE FACTS ABOUT STOCK WINDOWS

TYPE	OPERATION	APPROX. MINIMUM SIZE OF SINGLE UNIT		APPROX. MAXIMUM SIZE OF SINGLE UNIT		MAX. % OF OPEN AREA FOR VENTILATION	SCREEN LOCATION
		width	height	width	height		
DOUBLE-HUNG	Top portion slides down, lower portion slides up	1'8"	2'10"	4'	6'2"	50%	outside
SLIDING, GLIDING, OR ROLLING	Slides horizontally	3'4"	2'7"	5'4"	5'11"	50%	outside
CASEMENT	Hinged at side, swings outwards	1'6"	2'2"	1'11"	6'3"	100%	inside
AWNING	Hinged at top, swings outwards	2'7"	1'8"	4'1"	3'	100%	inside
HOPPER	Hinged at bottom, swings into room	2'7"	1'8"	4'1"	3'	100%	outside
STATIONARY OR PICTURE WINDOW	No movement; dimensions shown for stock sash with insulated glass*	4'4"	4'2"	5'8"	5'2"	—	—
BOW BAYS	Stationary or with some operating units (double-hung or casement)	6'7"	4'5"	13'8"	6'	Depends upon what type of operating units are selected	

**Stationary windows can be almost any size if glazed with single-thickness glass.*

STATIONARY, FLANKED BY MOVABLE UNITS



BOW BAYS

vides a variety of design possibilities, but also various ways to exploit natural cross ventilation. This is particularly true of awning and hopper types.

Windows are available in various degrees of completion:

1. Separate window units (not fitted in frames) are the least costly, but the saving is offset by increased installation labor, unless you do the job yourself.

2. Windows prefitted by the manufacturer, complete with frames, operating devices, hardware, and often integral weather stripping, are higher priced, but installation costs are low.

3. Windows prefitted by the manufacturer, as above, also come framed with two-by-fours in assemblies about 7′-9″ high. A two-by-four is provided on the bottom of each unit for nailing to the rough or finished floor. There are also vertical two-by-fours on the sides. These can be installed from floor to ceiling like studs. They come over-length so you can cut them to fit.

If you install your own windows, use only kiln-dried two-by-fours, two at each side of each rough window opening. When green lumber dries out, the studs may twist, causing the windows to bind. Use double two-by-fours above all openings up to 4′ wide, and two two-by-sixes or even two-by-eights on edge over larger openings. These are needed to prevent sagging and binding.

Never paint any surface that serves as a guide for either double-hung or sliding windows. Instead use linseed oil for wood preservation and wax for easy operation.

Before deciding on self-storing screens, be certain that there will be enough natural air circulation on hot nights if only the bottom half of double-hung windows can be opened. It's a decided advantage to let heated air exit near the ceiling. If you want to eliminate the chore of putting up and taking down screens, look into roll screens which spring up and roll up into a small housing on the inside and at the top of the window when not needed.

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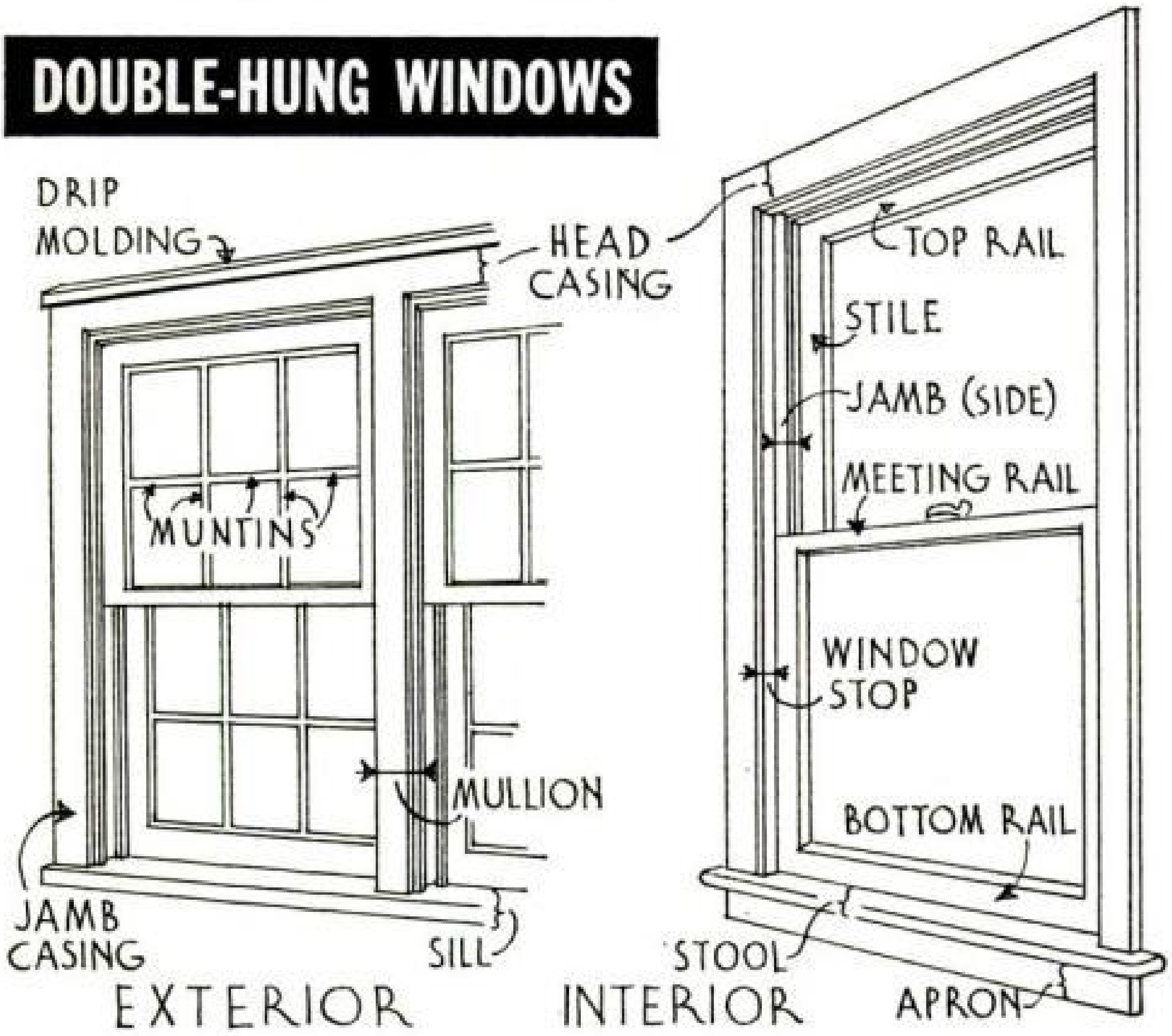
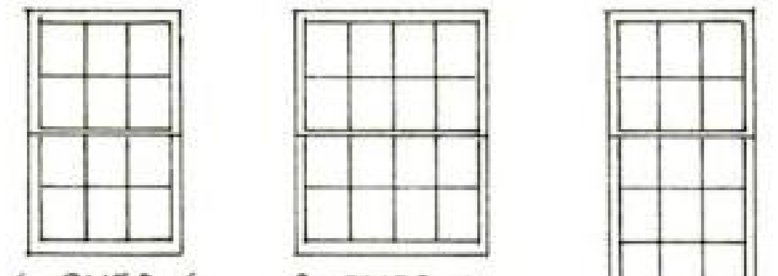
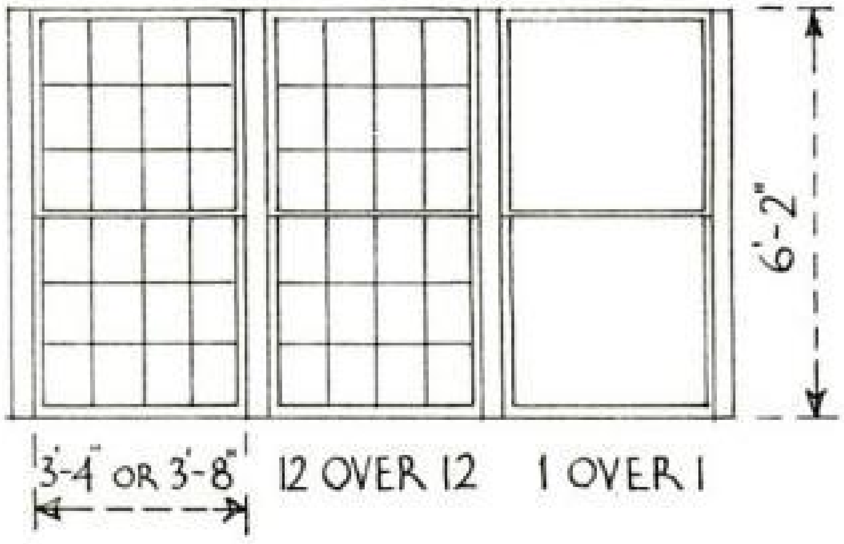
DOUBLE-HUNG WINDOWS



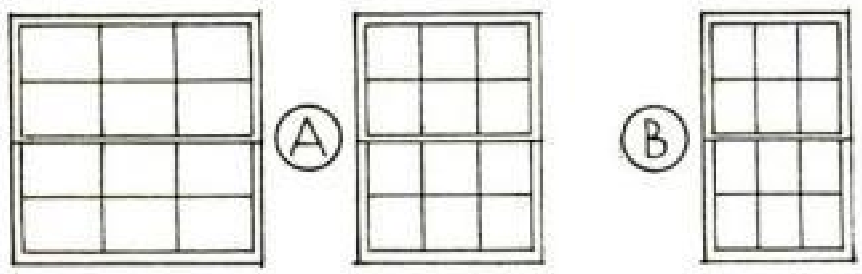
In double-hung windows, most familiar, the upper portion slides down, the lower portion moves up. When only the lower part slides, the window is called "single-hung," like those of the original Colonial houses. In the 19th century window weights on pulleys were introduced. These permit both portions to move up or down and to stay put. Present-day double-hung sash operate smoothly by means of coiled spring balances fitted into grooves on all stiles. The principal terms used for all types are shown at left. Dividers between panes of glass are called "muntins," while the vertical divisions between adjacent windows are known technically as "mullions."

In the first Colonial homes, windows had many small panes, the maximum size usually being 6″ wide and 8″ high. This pleasing proportion of width to height can now be bought in stock panes, about 8″ wide and 11″ high, or 9″ wide and 12″ high. Window sizes range from large ones, with triple or other combinations (as at left of door for living or dining rooms in drawing to right), down to single sash for bedrooms (shown at right of door in drawing).





When ordering double-hung windows specify the number of panes desired, using the terms given above and to right. If you want the effect of muntins but without their painting or cleaning problems, you can now order windows that have a single large pane of glass above and below the meeting rail (1-over-1) and then use interior snap-in and snap-out muntins made of wood or plastic. Typical measurements of modern 12-over-12 windows are sketched above.



Colonial windows provide a wide choice of panes in a ratio of three in width to four in height, except for use above a kitchen counter or for a bathroom. Above a kitchen counter, where you usually need a short window, horizontal or square panes (A at left) will be out, and you'll probably have to choose a window with vertical panes as in B.

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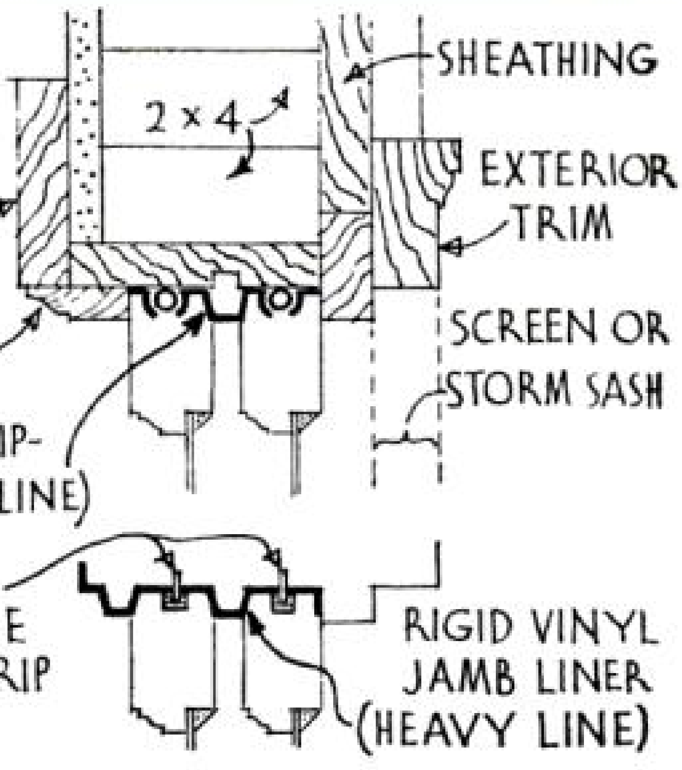
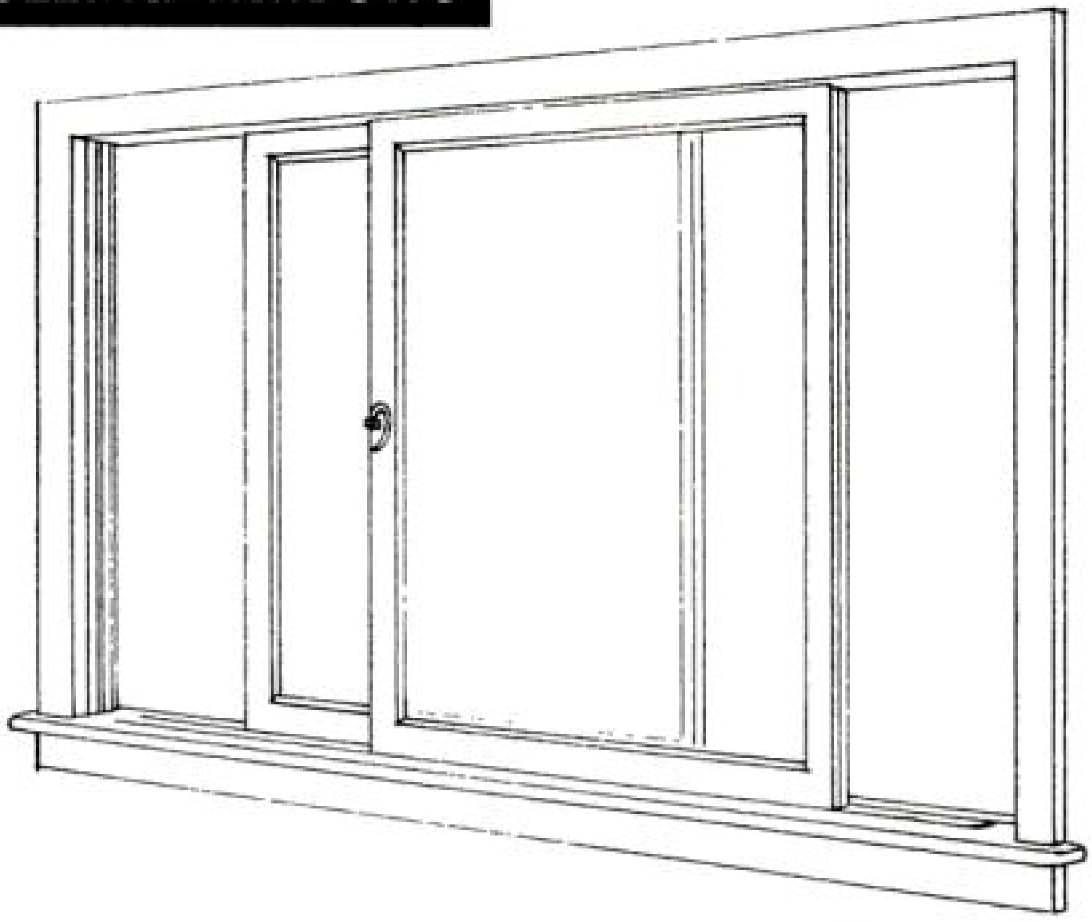
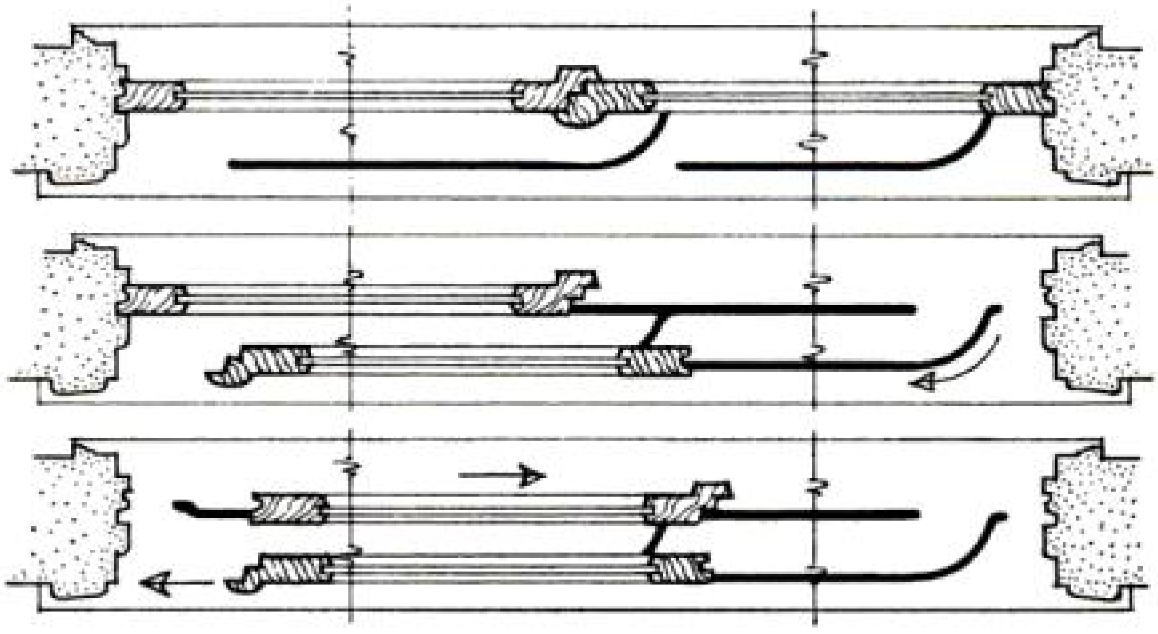
Factory-fitted sash with integral weather stripping are now offered by many makers. In some types the coiled spring balances are combined with a sheet-metal liner, which forms a continuous weather seal along the vertical edges of both upper and lower window units (heavy line in upper detail at right). Another stock type has a rigid vinyl guide, or liner, instead of sheet metal (heavy line in lower detail at right), as well as woven pile on the sides of a continuous-fin weather strip. Not only do the metal or vinyl liners stop drafts of cold air from coming in, or warm air from leaking out during the winter, but these surfaces require no maintenance and insure easy operation. One brand which has this feature also permits tilting the sash inward for easy washing of the outside face of the glass.



SLIDING, GLIDING, OR ROLLING WINDOWS

To identify windows that are like the double-hung type, but turned at right angles, manufacturers use various terms. The horizontal-sliding type is associated with contemporary design, because stock units usually have only one undivided pane of glass. Some makers provide a lift-out feature, which permits removing the sash easily from the inside for window washing. Some brands come with single-thickness glass, but with the option of removable storm sash (mounted in thin metal frames). Or, you can order insulating glass, which eliminates the storm-sash problem. At right are plan sections showing how one type operates. In the closed position (top) the two sash are on the same plane, with a triple-action locking device that tightens the two meeting stiles at the center, and also locks the window units against the weather stripping. Middle and bottom diagrams show how one or both units bypass each other.





Next Month: FIXED AND SWINGING WINDOWS

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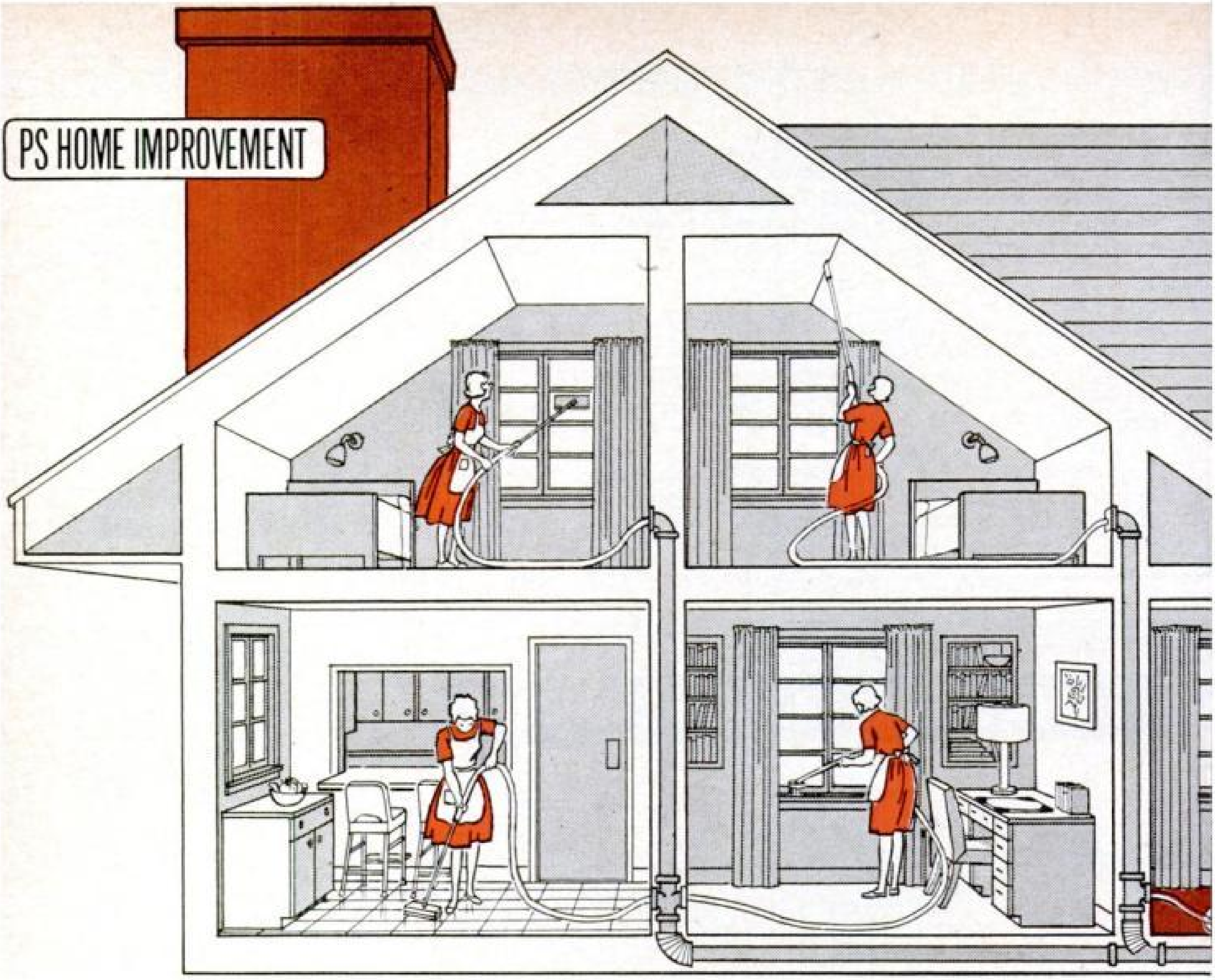

Central Vacuum System for Your Home?

Perhaps so. You can reduce the cost considerably by installing it yourself—as this man did

By E. F. Lindsley

CENTRAL vacuum systems for homes are entirely practical. They've been around for years in hotels and apartment houses, especially in Europe. Now, home systems are making news. You can buy them from mail-order catalogues, and you'll no longer find them the high-priced luxury they used to be. You can have one at much less cost if you install it yourself.

But let no one kid you. It's a lot of work to make all the piping and outlets a part of an older house. I know. I've just been through it—in our three-bedroom, two-story home—and there were problems. Was it worth it? Well, my wife now says she'd almost as soon give up central heating as part with our new high-powered central vac.

The system makes sense to us—and I sus-

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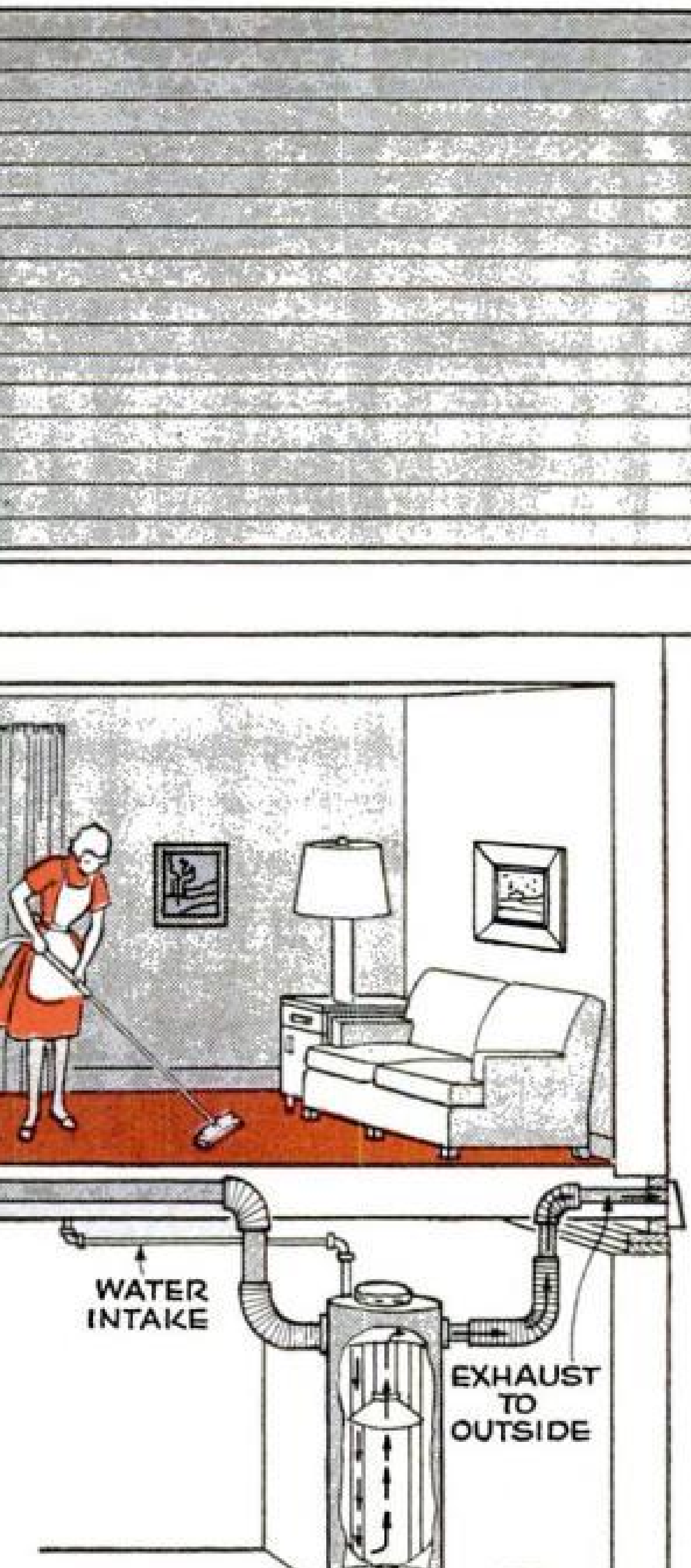
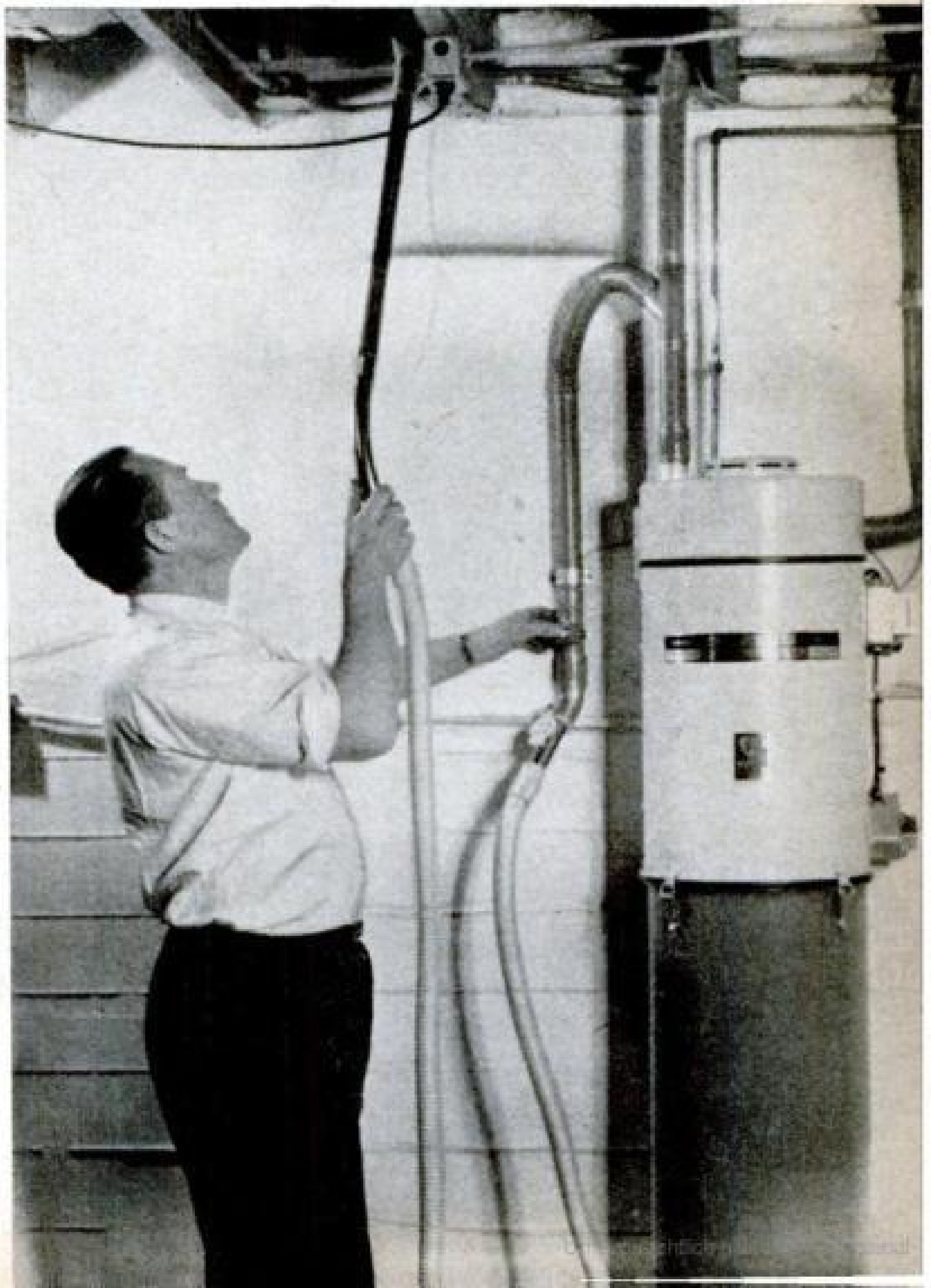


A hose 25′ long plugs into convenient outlet, will usually service two rooms. When not in use, hose hangs over a hook in a closet and accessories store in a convenient box, shown above. The system installed here has plumbing connections for discharging the dirt down the drain. But not all do. Below, the author snakes plastic tubing through the wall.



pect that a lot of you will eventually think so, too. Several manufacturers have introduced new systems lately. More are planning to. Some builders are installing them in premium homes.

We chose the new Kenmore Central Vac, made by Whirlpool and marketed by Sears in three price ranges—$200, $300, and $400, without installation.

Ours is the top of the line. It automatically flushes the dirt down the drain. The others are dry systems and the dirt containers must be emptied from time to

CONTINUED

time, a nuisance our flush system makes unnecessary.

Although it may seem logical to have a vacuum outlet in each room, a few strategic placements will satisfy the needs of most houses. Sears prices are based on three outlets in a three-bedroom ranch house. A trial with the 25′ hose showed us that four outlets would be enough for our two-story house, two outlets on the first floor, two upstairs.

With the self-flushing water-trap central unit, you have to cut into a sewer line. You'll also need to run in a ⅜″ copper water-feed tube. All types, wet or dry, exhaust clean air to the outside after it passes through the dirt separator.

Sears offers booklets showing how to route the suction pipes through the walls. The pipes are a tough plastic tubing about 1⅜″ in diameter. In older houses, you should count on a few structural blocks that aren't in the books. I got the pipes to the second floor by sneaking up the cold air ducts of the heating system. If you've got a ranch home you have no problems.

Once the basic channels are established, the plastic tubing, which I checked out and found highly fire-resistant, is readily cut to length with a tubing cutter or even a saw. Joints are made by slip-over couplings banded with pliobond adhesive and later taped. All bends are made with flexible tubing which is also cemented and taped at the joints.

Starting and stopping. There are different schools of thought on how a central vacuum system should be turned on and off. Ours charges with about three gallons of water automatically when it's started, and discharges the water automatically when it stops. Normally, my wife will start the machine by touching the switch at whichever wall outlet she uses first and then she'll let it run until she's through vacuuming the entire house. This eases the burden on our country-style sewage system.

To permit this feature of starting and stopping from any outlet, you'll need to run low-voltage control wires from each wall outlet back to two wires which eventually wind up at the remote-control unit on the machine. This is a good bit like a doorbell circuit that operates one bell from either front, back, or side door.

Other choices for controls would be a standard on-off switch at a suitable place, or a timer switch which can be set for a certain length of time, then will turn off automatically. The reason for the automatic feature is the quietness of the unit. This could lull a user into allowing the thing to run forever.

Plumbing is simple for the water-filter-type unit, but it must be done properly to avoid unwanted discharges of water. A well-installed S trap at the outlet and a securely mounted and coupled inlet at the top are all that's needed. A considerable amount of thought has been expended in engineering sanitation features. I was puzzled by an "air-gap valve" until I found out it was an ingenious way of avoiding any back-flow from the vacuum cleaner or the sewage line into the water-supply line.

A water-soaker. One feature novel to most housewives is the machine's ability to pick up water in modest amounts. An accessory item has a sponge on one edge for floor cleaning or window washing and a squeegee on the opposite edge. This tool licks up water with happy little squeaking noises and leaves a dry surface behind.

The wet-separator vacuum system has pitfalls, however. We encountered one the first time my wife turned the kids loose with it. After they had finished, I found the unit full of water and the sewer plugged. I finally got the drain open.

What did it? We'll never know, but I dropped the separator chamber before trying the vacuum cleaner again and found a heavy athletic sock, huge chunks of heavy plastic candy box, numerous bits of pencils, a dishcloth, a spool, and a paring knife. In short, if you have toddlers with all sorts of playthings on the floor, you'll either want to be awfully careful or get the dry-type machine.

Even after this experience, my wife didn't quite realize the incredible power of the machine and watched it snatch up one of our boy's socks from eight inches away. By now, however, she knew enough to leave the machine running so it wouldn't flush until she disconnected the drain line so it could discharge into a bucket. That way you can easily recover articles accidentally picked up.

I spent around 40 hours installing the system. I already had most of the necessary tools. Various supplies added about $50 to the basic cost. But, all in all, I can't think of anything we've bought lately that's given us so much practical value and convenience. ■ ■

Urheberrechtlich geschütztes Material

Ice-cream container peels off in layers

No spoon is needed to dig ice cream out of this tin-coated steel-foil container.

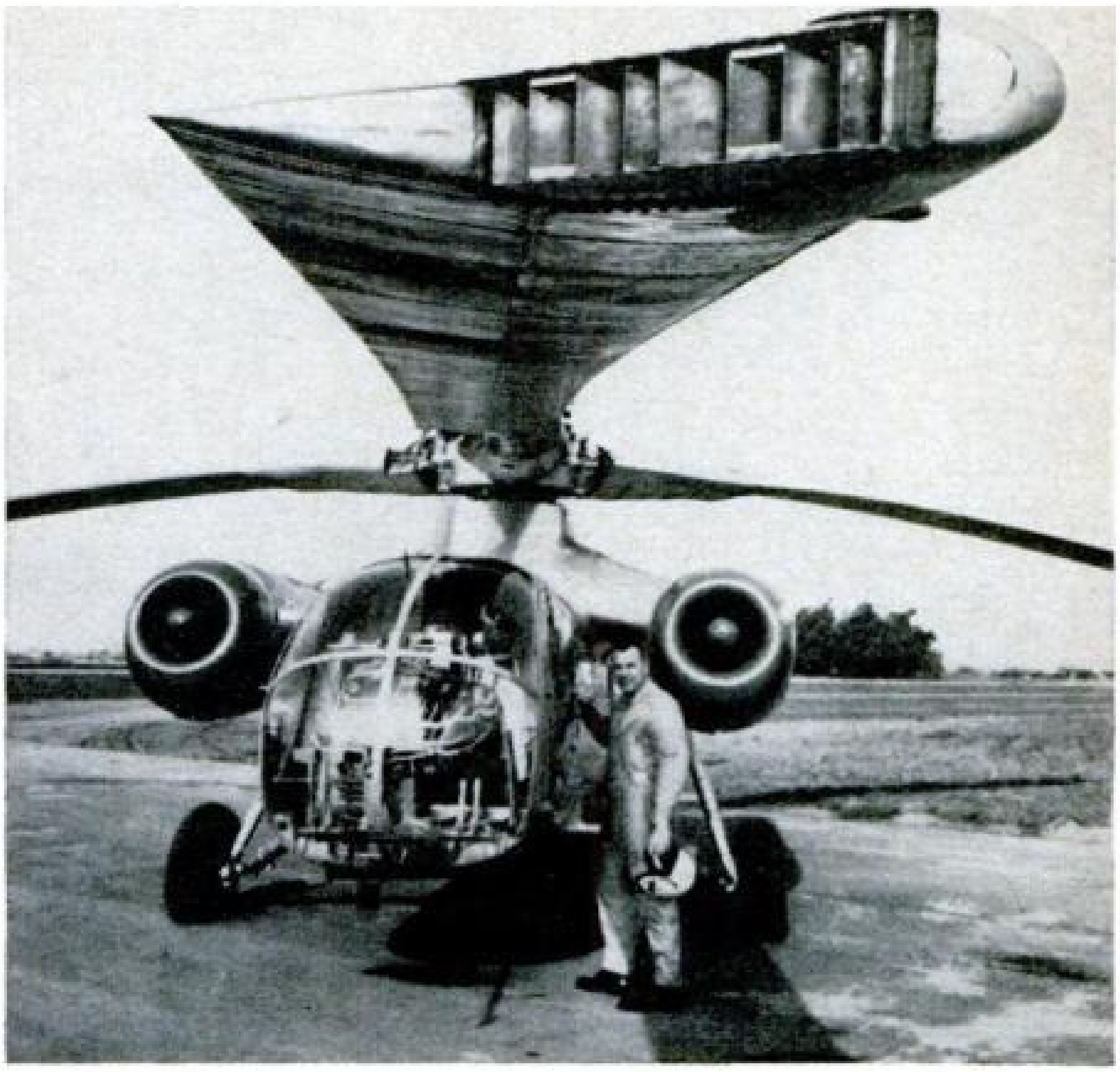
The extra-thin .002-inch foil is indented at lines dividing the colors and can be peeled off a layer at a time for slicing. The lid fits tightly back on to preserve remaining contents.

U.S. Steel made the package from its new thin foil.

Fingernail-size board flashes 576 lights

A tiny chip of silicon 5/8 inch long, half as big as in the photo above, is designed to record data on reconnaissance-camera film.

Fairchild's solid-state device contains 576 light-emitting diodes that flash singly or in computer-set combinations. Run by tiny battery, it replaces tubes, prisms, and camera lenses.



"Hot-cycle" helicopter spins rotor on own exhaust

Turbojets at the sides combine air and fuel to make hot gases that run the "hot-cycle" XV-9A helicopter built by Hughes for the Army. Ducted through the blades to vents at the tips, the gases whirl the rotor on a principle discovered by Hero of Alexandria 2,000 years ago when he rotated a sphere with steam from a kettle. Complex gears to turn the rotor shaft are eliminated.

Rambler's new Marlin is fastback hardtop

Combining a sporty fastback with hardtop roominess, the Marlin made its debut last month in Rambler showrooms. The standard 1965½ model is powered by American Motors' new 155-hp. Torque Command 232-cu.-in. six-cylinder engine. A 287-cu.-in. V-8 with 198 hp. and a 327-cu.-in. V-8 with 270 hp. are optional. The car has a 112-inch wheelbase, is 195 inches long and 54 inches high. It will carry six, has optional bucket seats.

Urheberrechtlich geschütztes Material

The last word in rec-room furniture

How to Build a Sing-Around Music Bar

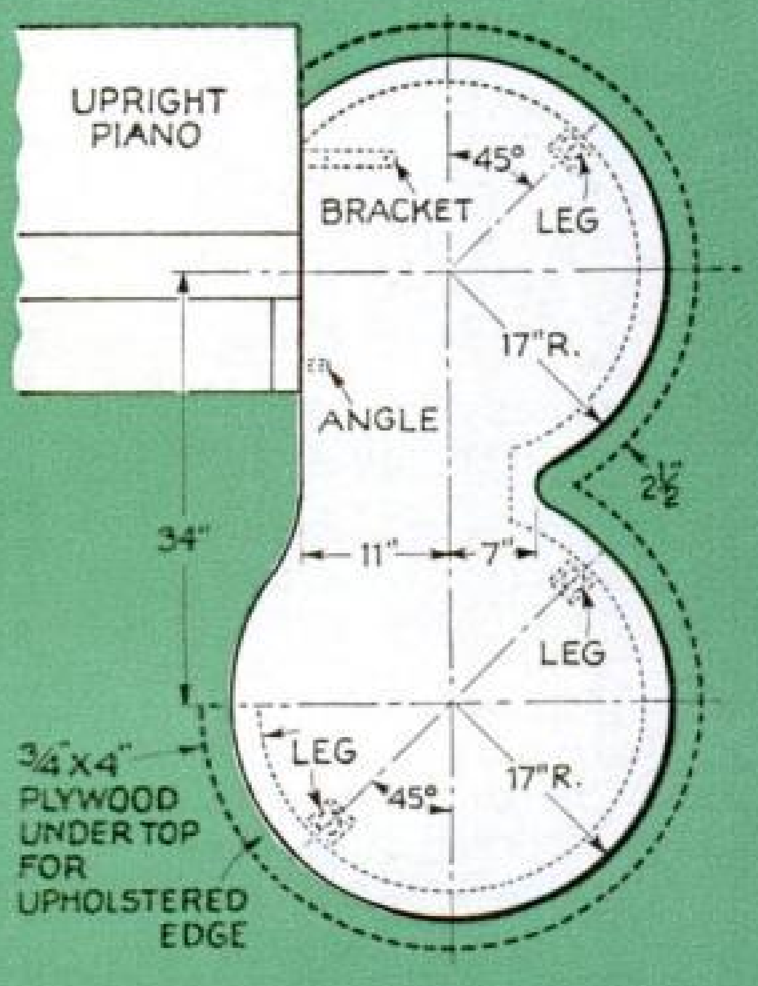
By Harry Walton

MUSIC and refreshments make the party, and here's a brand-new way to blend them—build a bar around your piano. This fresh and exciting idea is already a success in fine restaurants and many homes.

Black-and-white photos can't show the color and luxury of a music bar. Put somebody at the keyboard, and you have surefire entertainment that appeals to just about everybody. With a music bar in it, your rec room will be the busiest in town.

You can't buy one in furniture or department stores. Music bars are the creation of John A. Duffy. The Duffy Player Piano Company (408 Broad Ave., Palisades Park, N.J.) makes them to order, at about $300 for the bar alone. With a good piano, the cost runs into four figures.

But you're welcome to make your own, for



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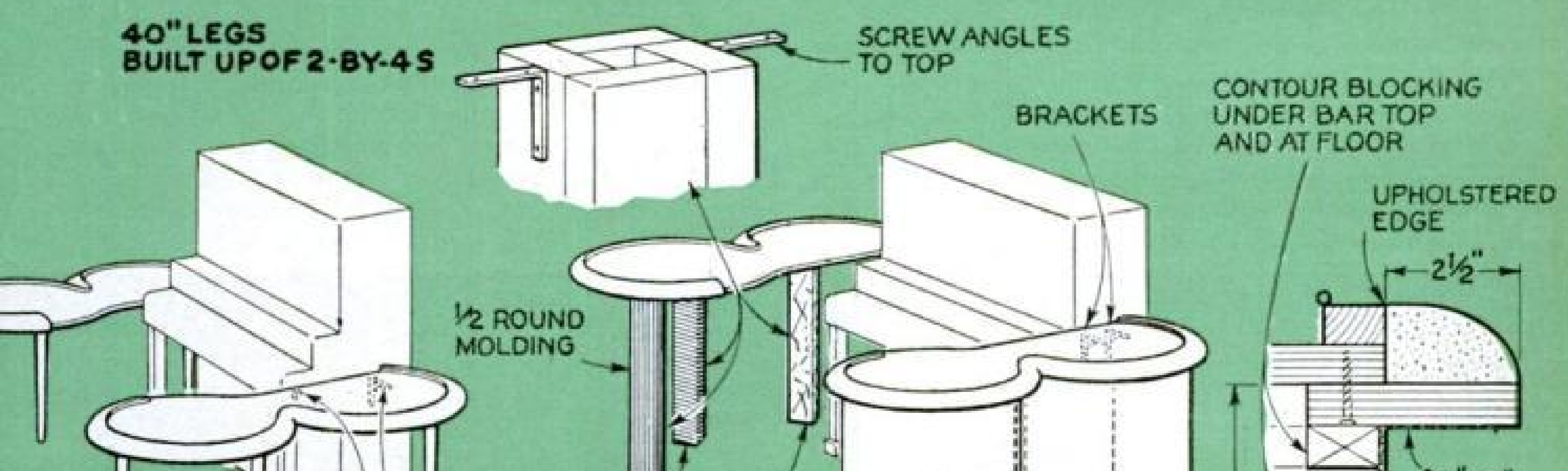
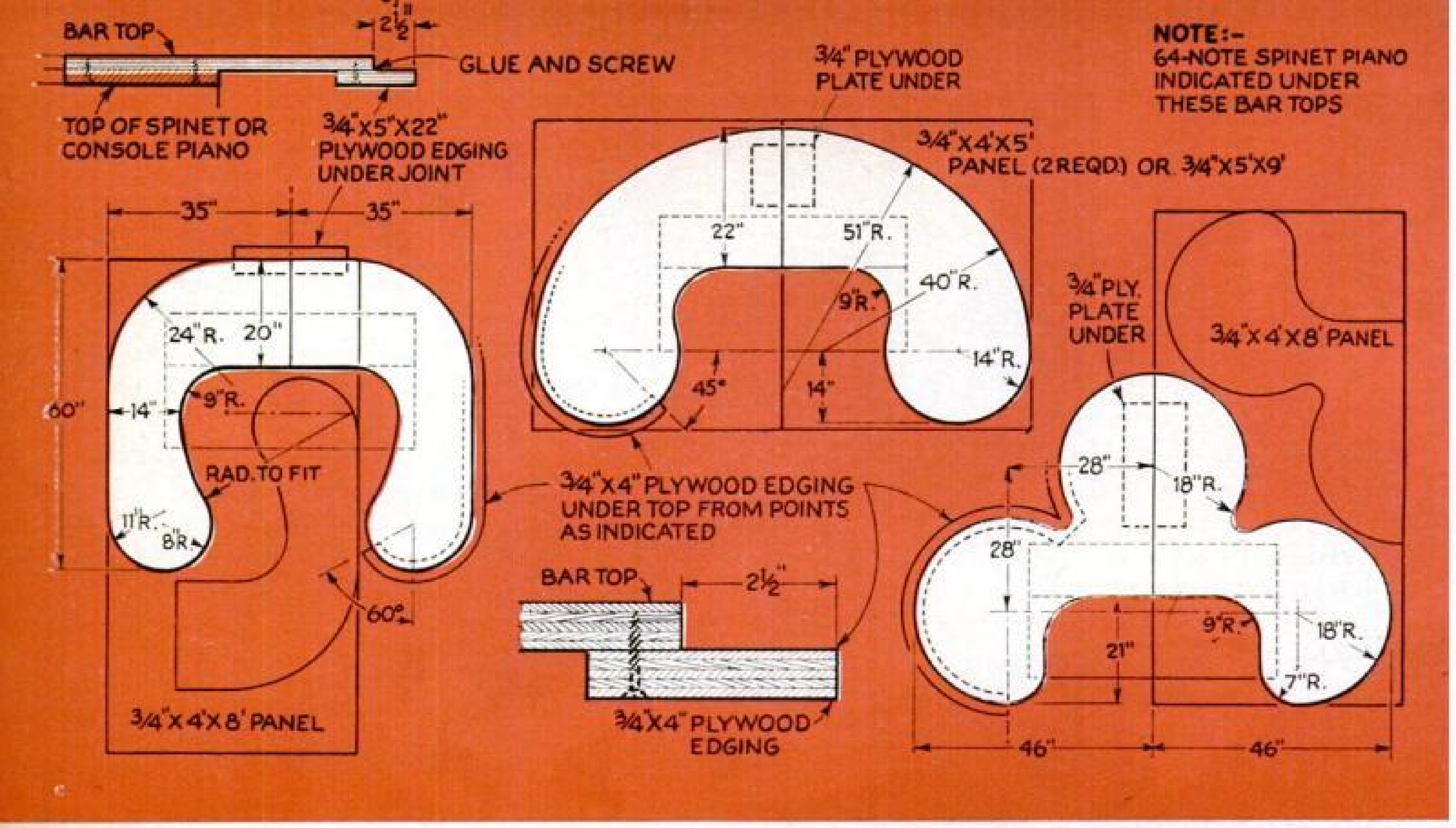
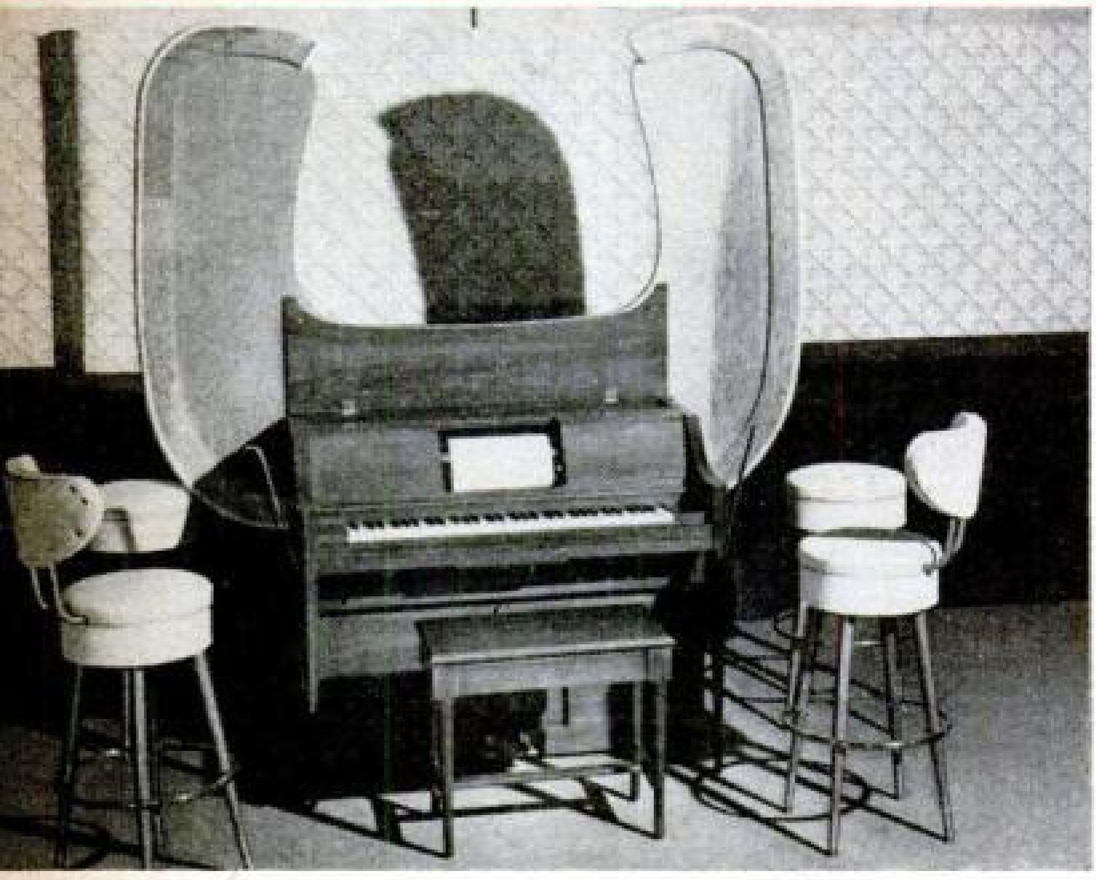
Urheberrechtlich geschütztes Material

People and fun go together around a piano bar. The one above is on a spinet-sized player. On upright pianos, two figure-eight bar sections are fastened to the sides as in the sketches below.



Urheberrechtlich geschütztes Material





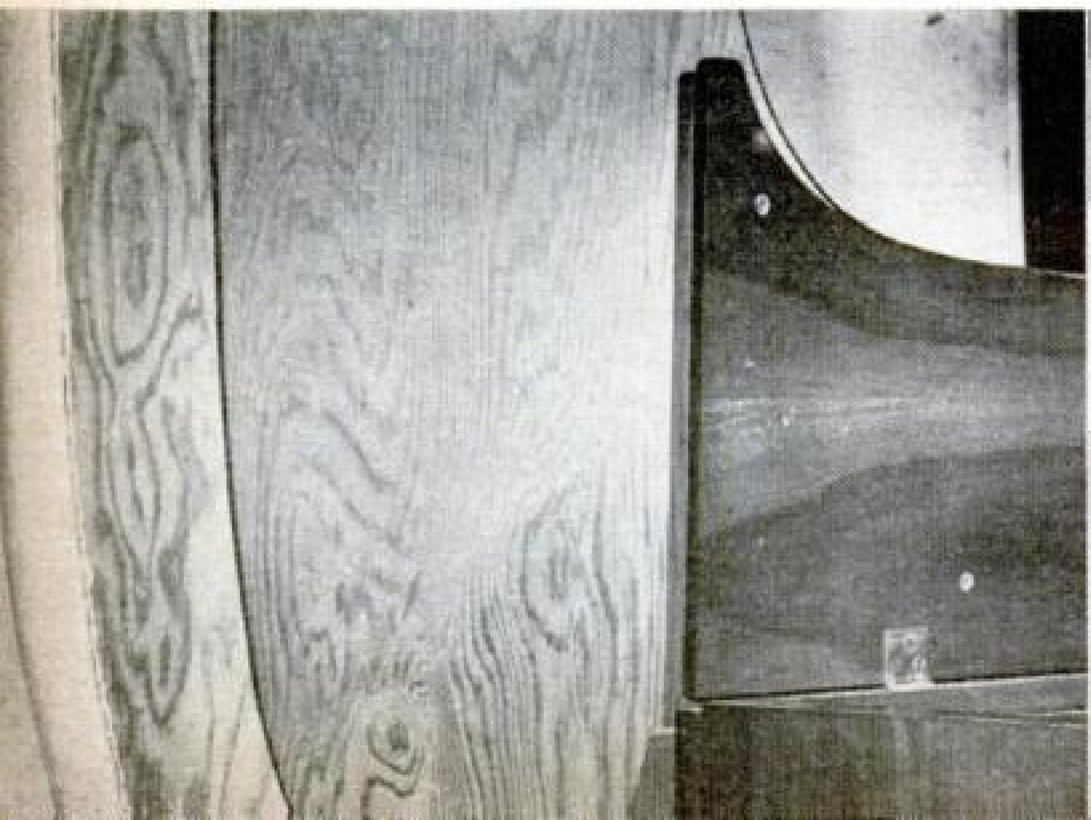
Any of these three shapes may be mounted on top of modern spinets, consoles, and electric organs. Check a full-size pattern against your own instrument before cutting any plywood. The bar swings up with the piano lid to permit tuning, as can be seen in the photo at left.

much less. Tailor it to suit your present instrument—upright or spinet, manual or player piano, or electric organ. Pick your color scheme from the big selection of plastic laminates (used for kitchen counters) and synthetic upholstery fabrics. Bar stools, too, come in a wide variety, from plain to plush, at $7 apiece and up.

Two basic designs fit old or new pianos. Modern compact ones can be moved out

The bar top is fastened to the piano lid with four screws. A plywood edging (below, left) is fastened under the outside contour, and a narrower strip on top, to build up thickness for the upholstered rim. Fabric drawn over foam rubber is tacked or stapled to the underside.

To conceal the harp frame, which would be exposed in pianos pulled out from the wall, a sheet of perforated, patterned hardboard is fitted over white cloth. Edges are trimmed with molding or plain strips. This kind of closure doesn't affect the tone of your piano.



from the wall, the bar mounted on the lid, and people seated behind and on both sides of the piano. The top will be 40″ to 43″ high—just right for 30″ stools.

Three shapes for such lid-mounted bars are shown. Each consists of two halves to be cut from standard ¾″ plywood sheets and joined. Cutting is easy with a saber saw, which you can rent.

Older upright pianos are too high for a bar on top. Instead, build two sections and fasten them to the sides, with brackets at the piano and ready-made table legs at the outside, as in a drawing. This makes the bar top 30″ high, suitable for chairs.

For stool height, build 40″ legs of two-by-fours and cover them with molding, rope, or laminate. Or build a column-like base by nailing shaped blocks to the floor and under the bar top, and bending thin hardboard or plywood around them. Be sure the overhang provides knee room. Cover the base with linoleum, plastic, or upholstery fabric and brass tacks.

Make a pattern for piano-top bars on wrapping paper or cardboard sheets taped together. To draw big radiuses, swing a pencil on a length of picture wire or lamp cord. Center the pattern on your piano to check its size and fit.

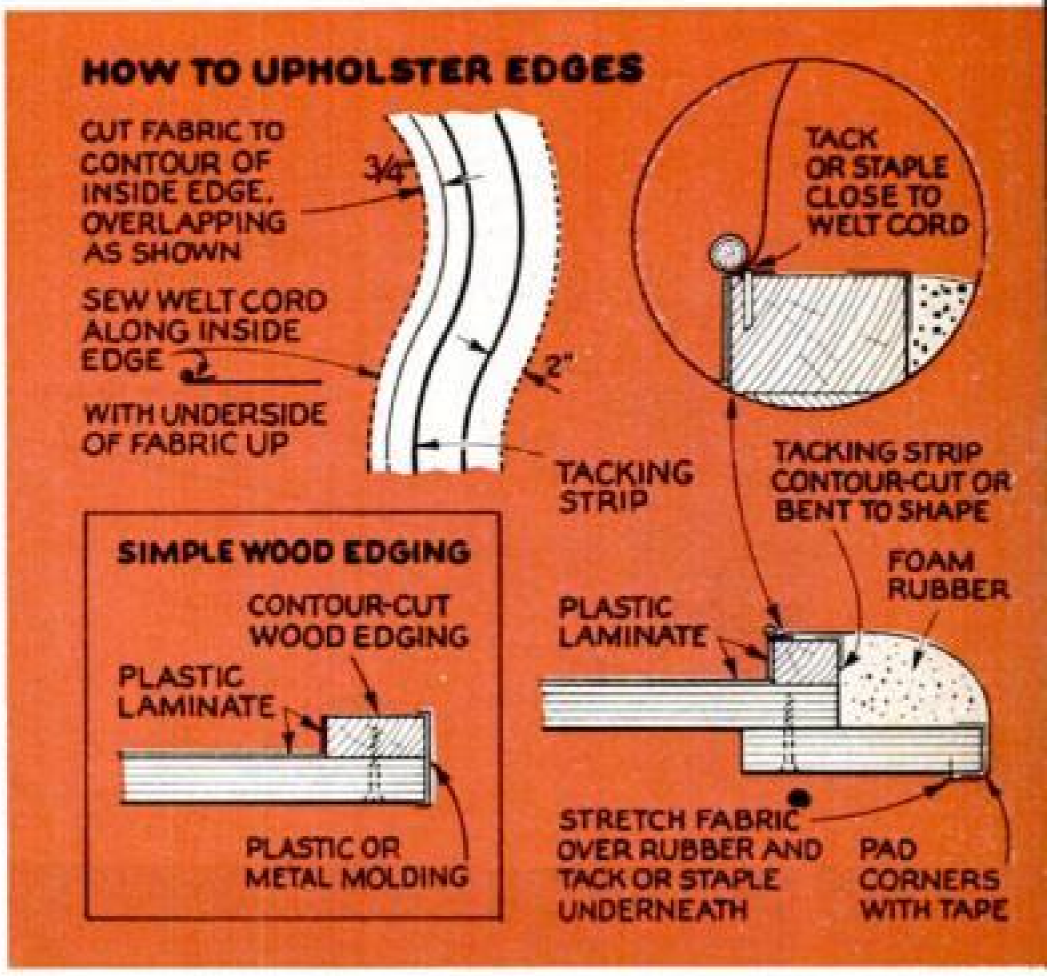
Draw the pattern on the plywood so that the waste will provide edging and joint plates. Use a power sander or a rasp and sandpaper to smooth the cut edges.

The edging fastened underneath to make an upholstered rim will bridge the joint. Cut it 5″ wide there. If edging isn't used, glue and screw an 8″ wide plywood plate across the joint. Countersink four holes from the underside of the piano lid and fasten the bar to it with wood screws.

Edge treatment may be no more than a metal or plastic molding. For a thicker edge, glue a second thickness of plywood, about 2½″ wide, around the top surface. The upholstered edge shown requires a 4″ wide strip on the undersides and a narrow tacking strip on top, both cut to contour.

On sharp corners, use masking tape. Cut upholstery fabric to the same contour, about 7″ wide. Sew a welt cord along the inside edge, leaving a ½″ flap for tacking. Cut foam rubber to fit and stretch the fabric over it, tacking beneath.

Apply counter surfacing to make the bar top spillproof. Plastic laminate, in a flexible 1/32″ thickness or 1/16″-thick sheet, is applied with contact cement. Linoleum may also be used as a counter surface. ■ ■



Support the overhanging part of lid-mounted bars on a bracket at each side of the piano. Bend the brackets from ⅛″-by-1″ strap iron or aluminum. Screwed to an under edge of the keyboard wings as shown, they won't leave screw holes visible if subsequently removed.

A luxurious upholstered rim is built up as in the drawing above. To close the ends, cut thin plywood pieces, cover them with fabric, and tack in position as below. How you can make an attractive thick edge without upholstering is shown in the drawing as an alternate method.

Urheberrechtlich geschütztes Material

5 Accessories

By William G. Waggoner

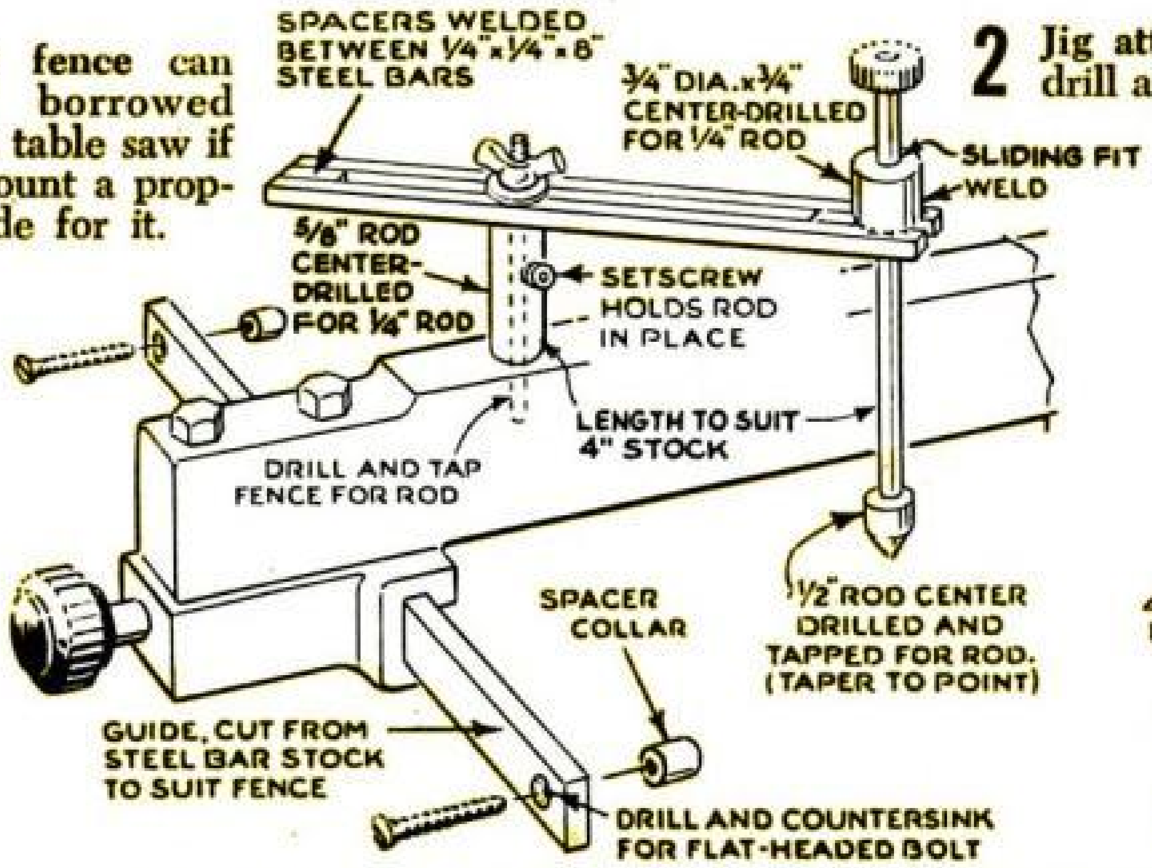
TIRED of working around a porcupine of clamps whenever you set up your drill press for an offbeat chore? You can avoid these Rube Goldbergs with accessories that are a pleasure to use.

Start with what every drill press should have—but doesn't—an adjustable table fence. More than likely, the one clamped to your bench saw can be put to double duty here. If not, a new or salvaged Shopsmith job is a good bet.

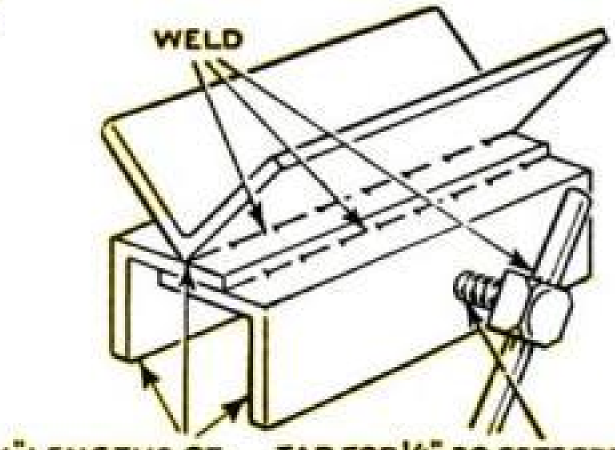
To adapt the fence to the drill press, bore and tap holes in the left edge of the table for a guide made from steel bar stock, a pair of spacer collars, and two bolts. With this fence setup alone, you can handle a variety of drilling, routing, and drum-sanding chores quickly and accurately.

But don't stop there. Your adjustable fence is an ideal anchor for three other

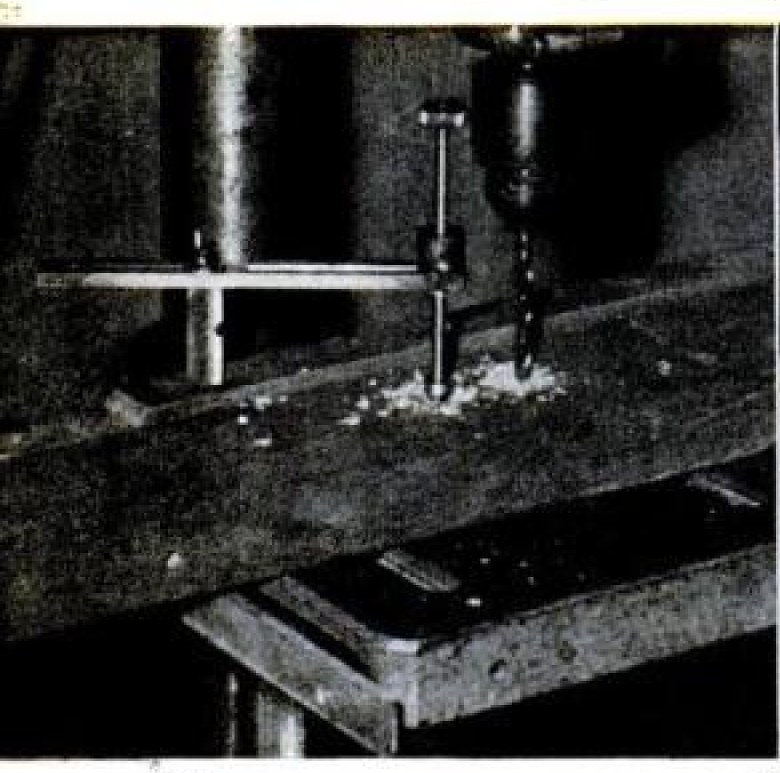
1 **Rip fence can be borrowed from a table saw if you mount a proper guide for it.**

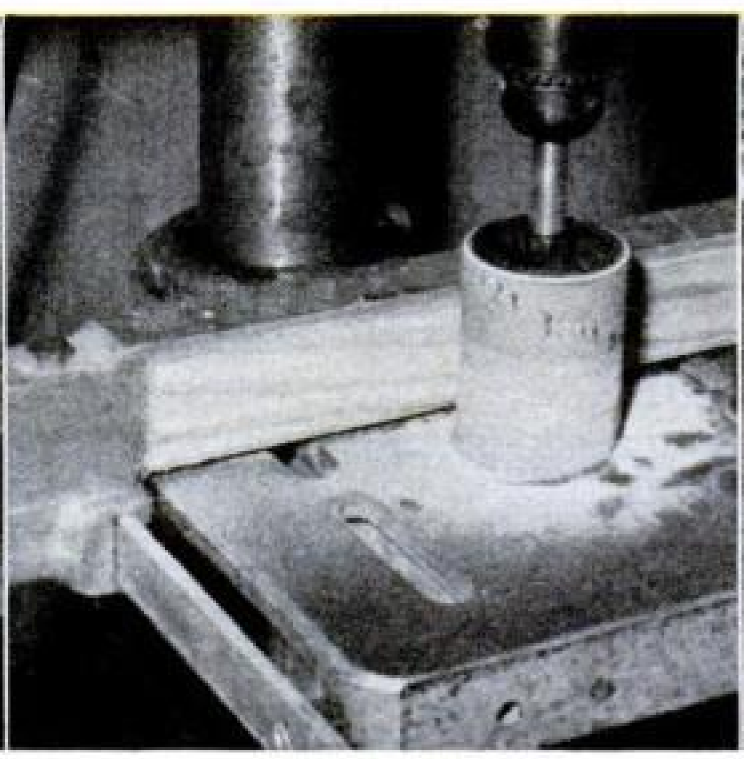


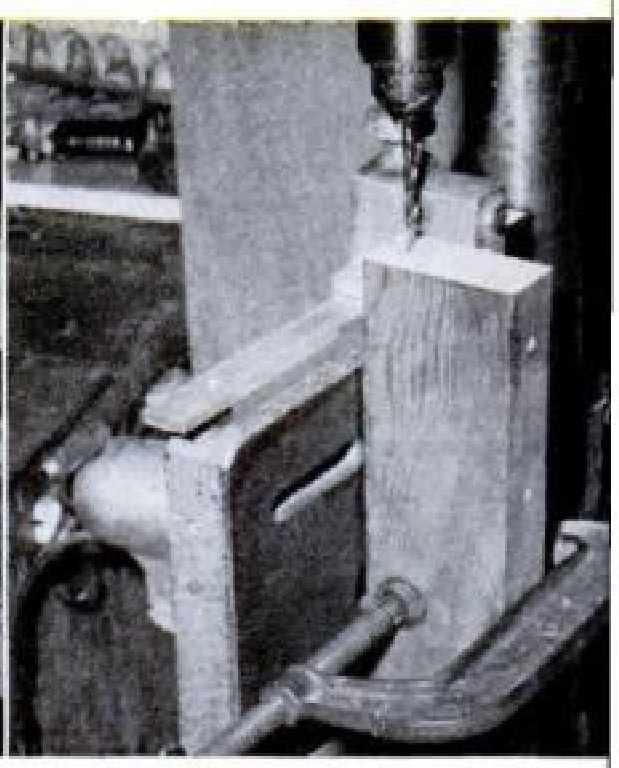
2 **Jig attached to the fence makes it easy to drill a line of holes the same distance apart.**



3 **V block made of three lengths of angle iron welded as shown above is another accessory that you can often use with your drill press.**







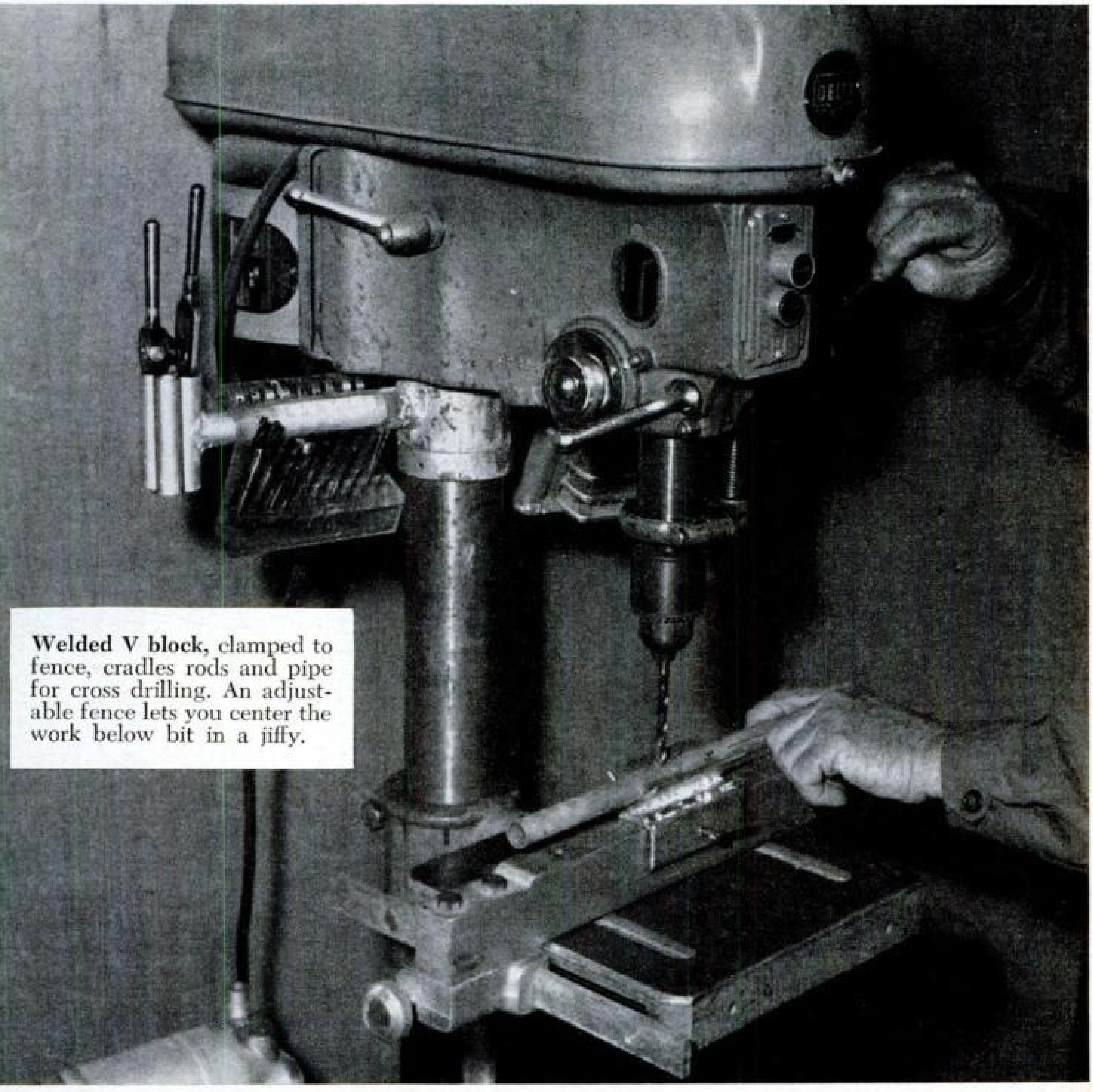
Three ways you can use a table-saw fence on a drill press are shown. At left, an accessory drilling jig automatically insures equidistant holes. Let the tapered guide pin drop into a hole you've just drilled and you're set to drill the next one—at the right spot. Straight moldings, pickets, and slats are accurately sanded to predetermined thickness with center setup. Up-end the table (right) and the fence offers a clamping surface for end drilling. Dowel-pin holes for 45-degree miter joints are just as easy to bore, with the drill-press table accurately tilted.

Urheberrechtlich geschütztes Material

for Your Drill Press

accessories: One is a V block, which you can clamp over it to cradle and center rods and pipe of any diameter for drilling. Another is a jig that lets you bore equal-spaced holes. Still another is an auxiliary table—again attached to the fence. This overriding platform offers: fast and efficient contour sanding, accurate pattern sanding, automatic and precise shape routing.

Finally, if you're tired of reading machinist's charts, and of squinting at miniscule numbers stamped on drill bits and taps and dies, shape a little plastic holder to hold the complementary ones in vertical alignment. Make it as shown on the next page. Heat ⅛" plastic in the kitchen oven and form it over ½" pipe. Then clamp the plastic unit to a nipple threaded into a threaded coupling welded to the drill-press head. Weld two or three pipe sleeves vertically at the other end of the nipple to hold the tap and die tools.



Welded V block, clamped to fence, cradles rods and pipe for cross drilling. An adjustable fence lets you center the work below bit in a jiffy.

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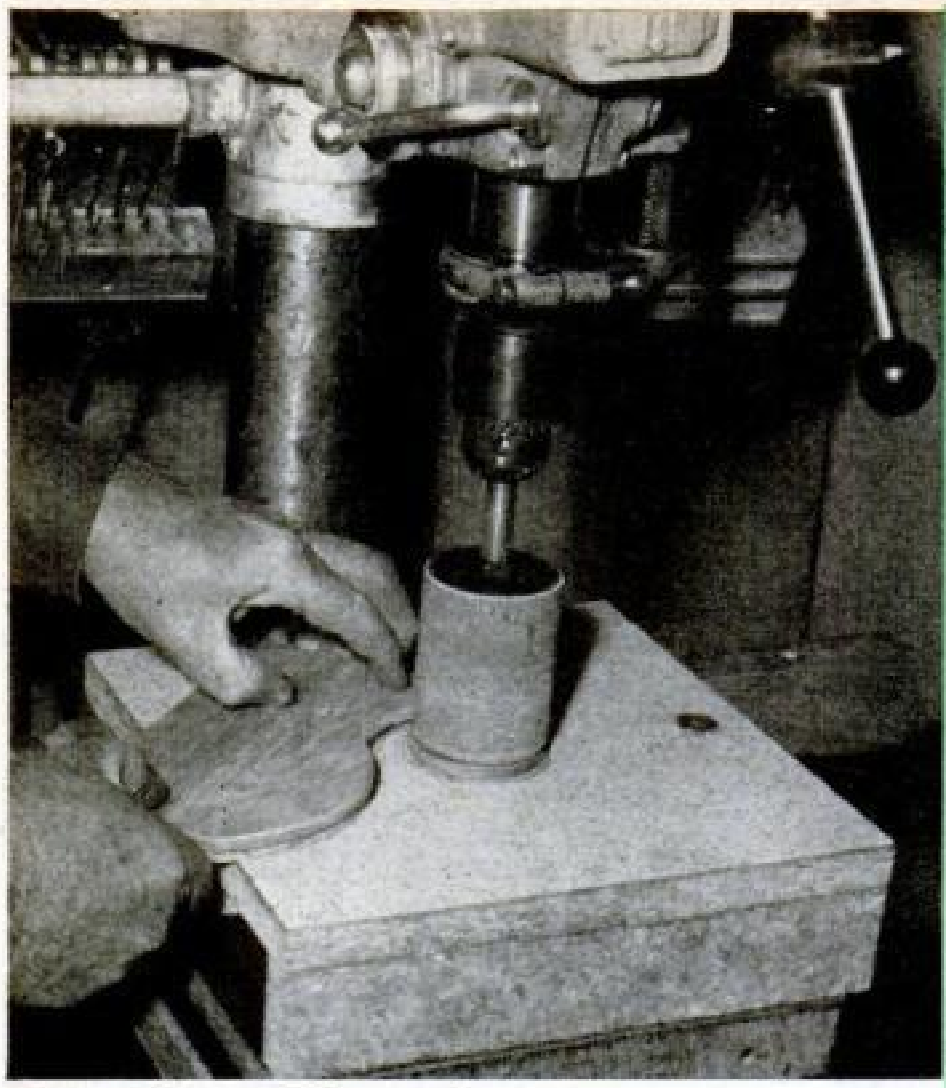
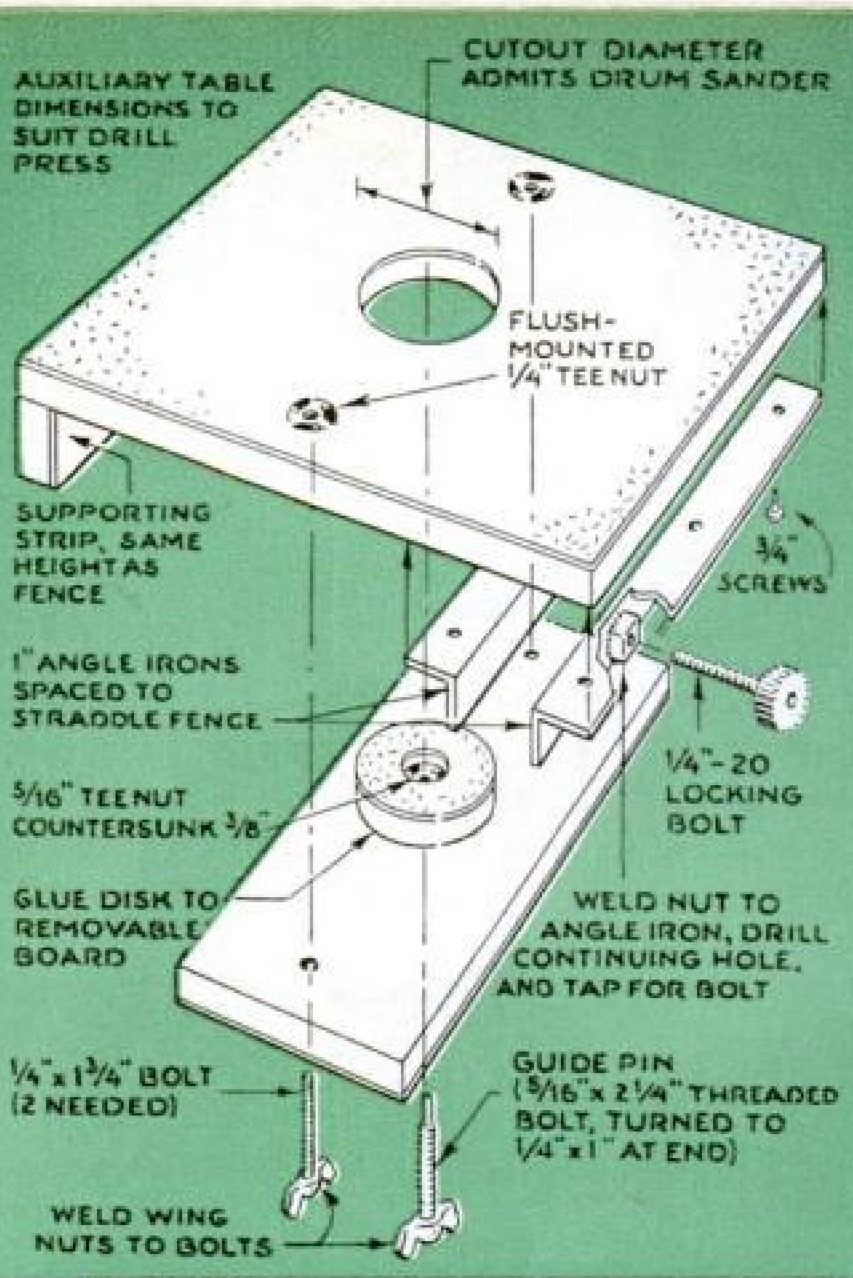
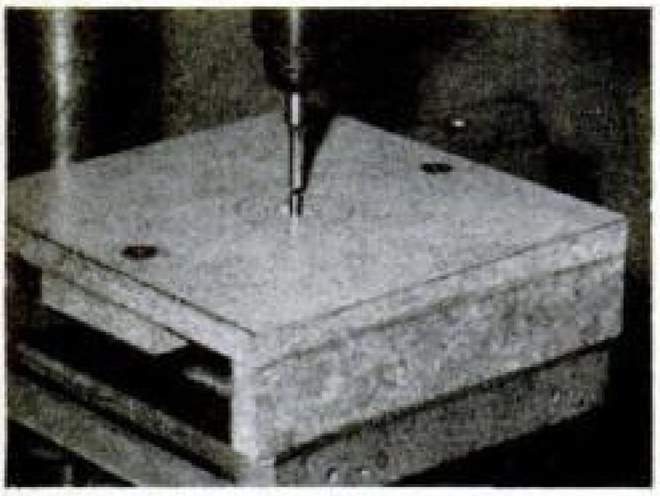
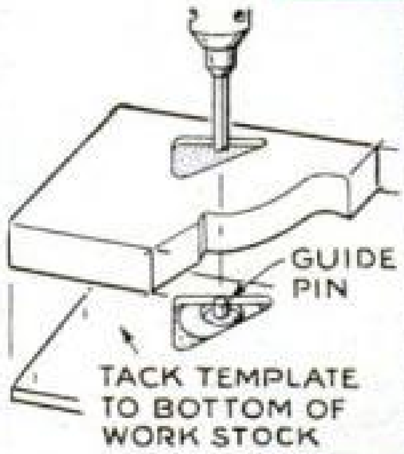
Urheberrechtlich geschütztes Material

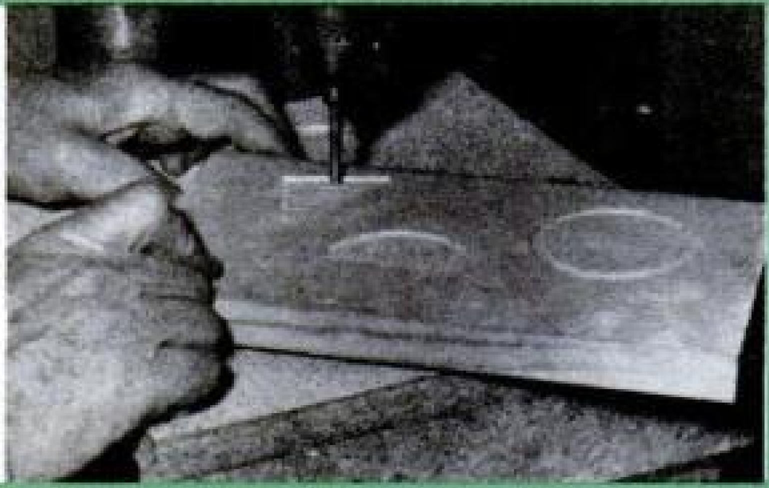




4 **Auxiliary table** cut from counter topping lets you use all the area of drum-sander sleeve. For pattern sanding (above), use a wood washer under the drum.

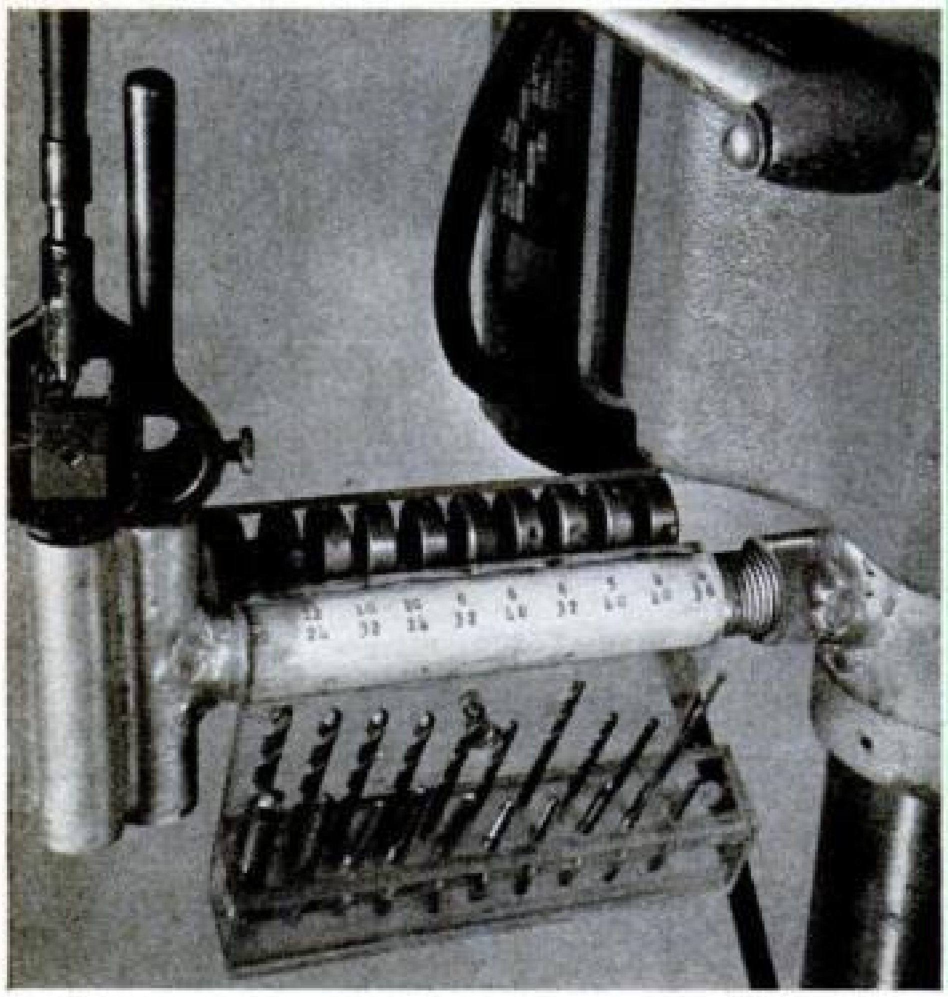


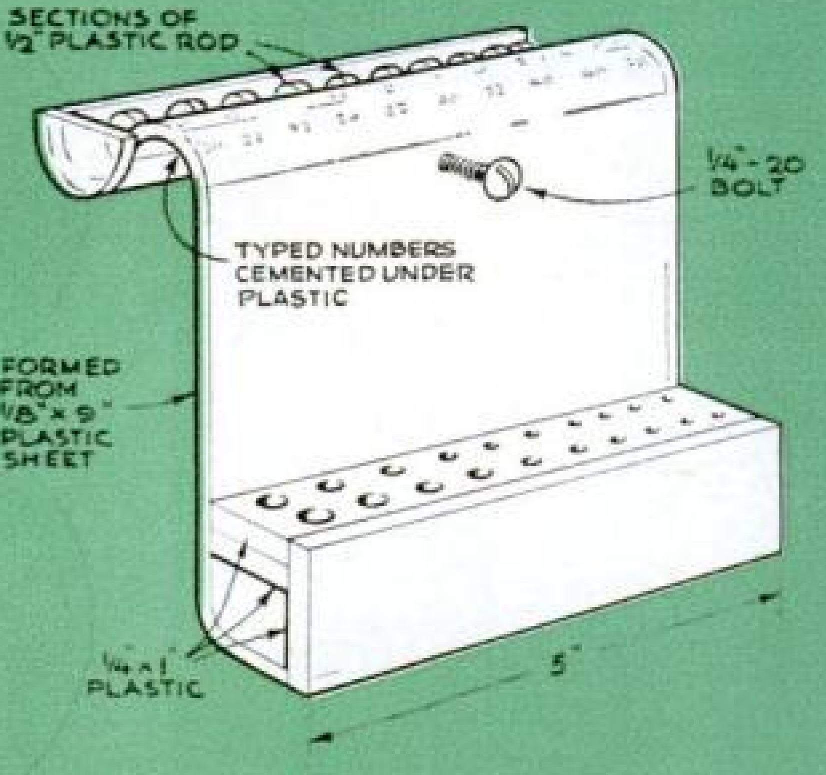




For pattern routing, make sure the guide pin of the auxiliary table is directly under the router. The variable adjustments in the fence and regular drill-press table make this easy.

The aligned router bit follows the contours of cutouts in master pattern tacked under the wood you're routing. Move the work around to the limits the pin will allow.





5 **Plastic holder** on side of drill press keeps bits in line with the corresponding taps and dies. Make it as above. ■■

Urheberrechtlich geschütztes Material

It really cuts grass!

That New Flying Lawn Mower

By Jackson Hand

CHANCES are, you've already heard about a new "flying lawn mower." If you haven't yet seen it, you eventually will. The first time I did, I was skeptical. A lawn mower without wheels? Crazy! But that's exactly what Toro's new Flymo lacks—wheels.

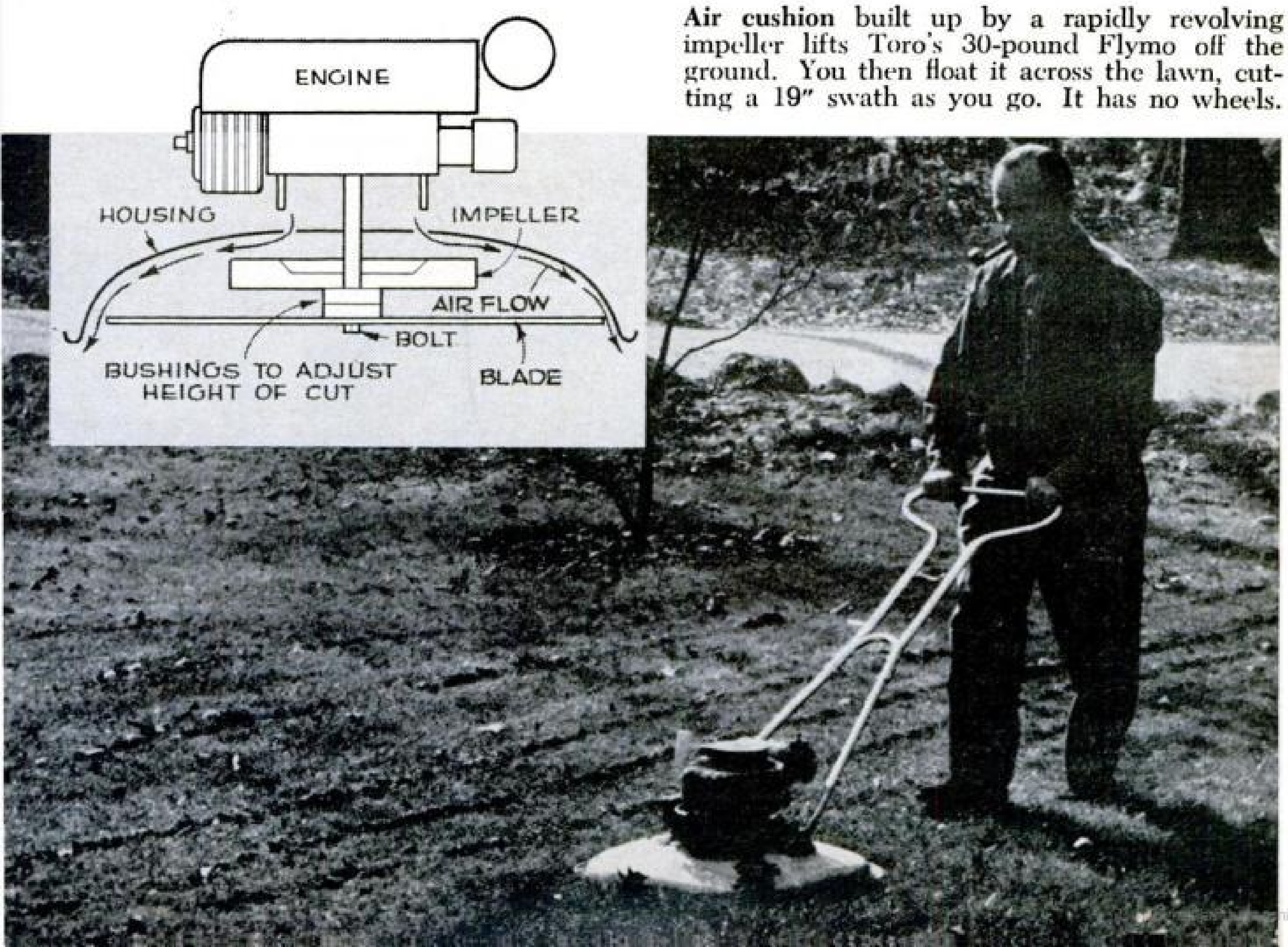
Nevertheless, it does what every lawn mower should do. It cuts grass. You might think it would scuff the turf, perhaps scalp high spots. It doesn't.

While it mows, it floats around the lawn like some kind of space-age bubble with a gasoline engine bolted on top. Mounted on the shaft, just above the cutter blade, is a semi-rigid plastic impeller 11 inches in diameter. With the 2½-hp. Tecumseh engine governed at 3,500 r.p.m., this big impeller sucks in air through four holes in the fiberglass housing, up under the motor. This puts pressure, a cushion of air, under the dome-shaped housing. What happens? The same thing that happens to the big commercial and military hovercraft. The difference in air pressure provides lift. The machine doesn't touch the ground.

As a result, the Flymo is just as happy moving from side to side as it is moving forward and backward. The merit of this feature is one you discover quickly. Exert a little lateral pressure on the handle, and the mower floats sidewise. You move into tight quarters around trees or shrubs. A little push-pull-twist, and you float the mower around until it has mowed all the hard-to-hit spots. This is the major advantage of the new machine. Nothing that I have ever cut grass with is as easy to put into tight spots or to work around obstructions.

This every-which-way feature of the machine causes the first thing you won't like

[Continued on page 186]



Air cushion built up by a rapidly revolving impeller lifts Toro's 30-pound Flymo off the ground. You then float it across the lawn, cutting a 19" swath as you go. It has no wheels.

Shopping for

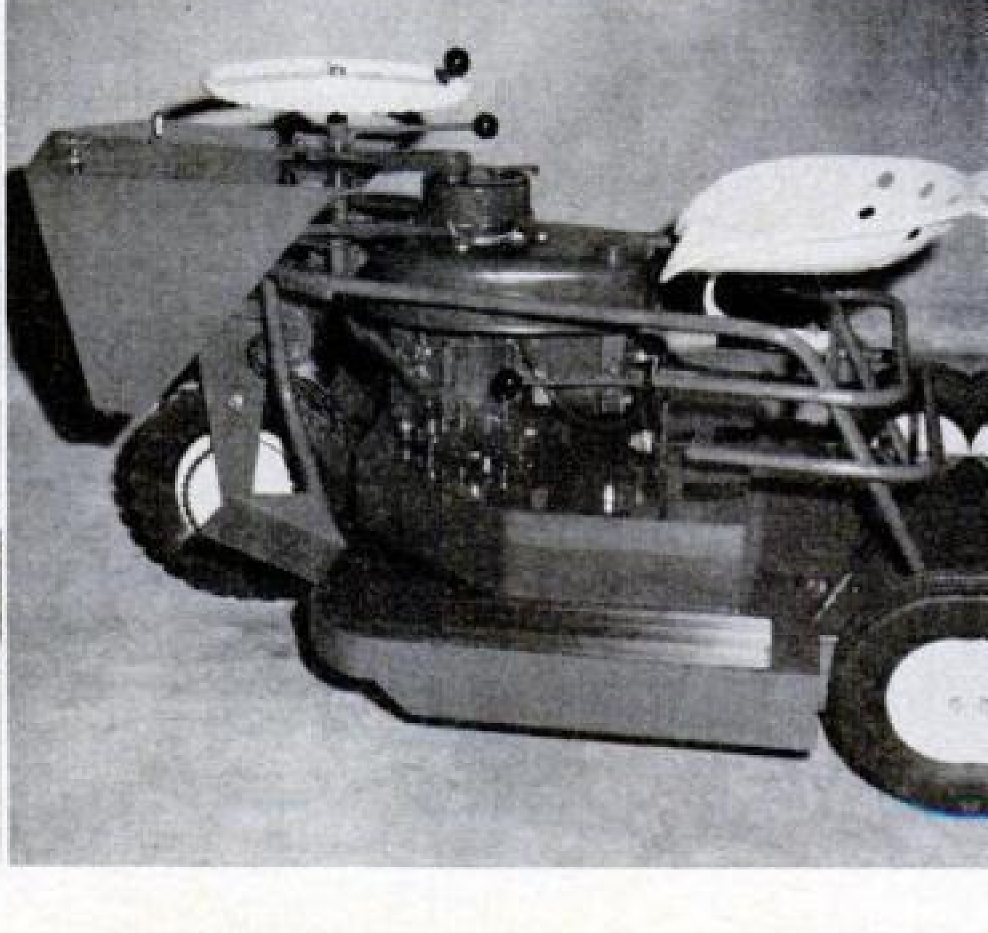
STYLING IS THE KEYNOTE IN '65 MODELS

Some look like baby tractors (Homelite) . . .

Here a reel rides in back (Pennsylvania) . . .

Many cutters have separate wheels (Reo) . . .

There's even a three-wheeler (Swisher) . . .



Urheberrechtlich geschütztes Material

a Riding Mower

By Sheldon M. Gallager

THE riding mower is one of the hottest-selling pieces of yard equipment to come down the pike. Its sales for last year: a whopping 10-percent boost over the previous year against only five percent for other types of mowers and yard machines.

This year, riding mowers are expected to cut an even bigger swath. How come? Aside from the obvious luxury of being able to sit while you work, the riding mower is the logical next step in upgrading a hand-guided power mower. It's a single-purpose machine designed to do one job especially well. Many experts agree that it probably does a better mowing job than even a tractor with a mowing attachment. At the same time, it costs considerably less than a tractor but affords the same kind of fun.

A mower or a tractor? So many of today's riding mowers are styled to look like suburban tractors that it's sometimes hard to tell just what you're getting. Don't expect a mower to do a tractor's job. And don't think you're getting a tractor just because the maker offers a cart or dozer blade as accessories.

Most experts agree that a tractor, to do useful work, should have a minimum of six hp. and preferably eight or nine. Not many riding mowers are in this class. If you're going to saddle a mower with extra tasks, be sure it has the power to do them—and expect to pay a top price. If what you really want is an all-around yard machine, you'll be better off investing in a true tractor.

Size and weight. Within reasonable limits, the heavier the machine, the better its traction—provided it has adequate power. Even a modestly powered machine may not get the full benefit of its power if it's too light, simply because its wheels will slip before full power can be applied.

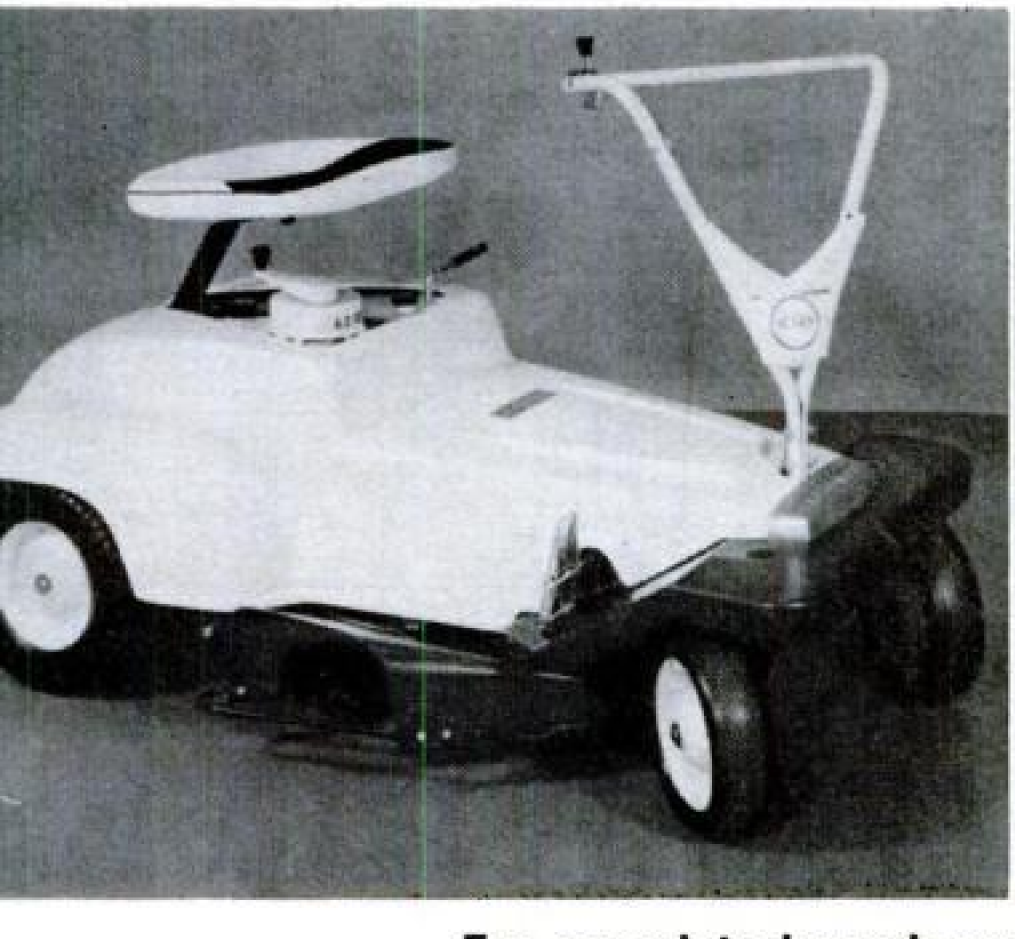
Ponder the "weight" column, in the chart on the next two pages, carefully.

The type of lot you have also affects the size of mower you choose. The larger a machine is, especially in width, the more stable it will be on hilly ground. A narrow machine can be tippy on a slope.

Look for big wheels. Large, fat-tired wheels roll more easily over rough turf than small ones and dig in less on soft ground. The driving wheels, especially, must be big for good traction. Other things being equal, pneumatic tires give better traction and riding comfort than semipneumatics or

[*Continued on page 218*]

Many have streamlined bodies (Sears) . . . And some look like sports cars (Moto-Mower).



For complete buyer's guide, see next two pages

Urheberrechtlich geschütztes Material

Facts and Figures on

MAKE	MODEL	APPROXIMATE PRICE	TYPE OF CUTTER	WIDTH OF CUT (in.)	BODY DIMENSIONS (inches) LENGTH	BODY DIMENSIONS (inches) WIDTH	APPROXIMATE WEIGHT (pounds)	HEIGHT OF CUT (inches) MAX.	HEIGHT OF CUT (inches) MIN.	CLOSENESS OF CUT (inches) AT FRONT	CLOSENESS OF CUT (inches) AT SIDE	TYPE OF CUTTER SHAFT BEARING	HAS BRAKES
A.M.F. WESTERN TOOL	HOMKO 1238	$280	rotary	24	48	25	228	3½	1 3/16	9½	⅜	ball	yes
	HOMKO 12660300	$450	rotary	30	61	34	328	4	1½	11½	½	roller	yes
ATLAS	ATLAS AIRE R25A	$270	rotary	24	54	29	224	3½	2	15	1	ball	yes
BLACK, SIVALLS & BRYSON (TURFRIDER)	OLYMPIC	$130	rotary	24	45	29	125	3	1½	10	½	ball	yes
	MONTERREY	$210	rotary	24	48	33	201	3¼	1¾	11	3	ball	yes
	PINEHURST	$250	rotary	24	48	33	206	3¼	1¾	11	3	ball	yes
	GREENBRIAR	$325	rotary	24	48	33	231	3¼	1¾	11	3	ball	yes
BOLENS	SUBURBAN 24	$220	rotary	24	41	25	185	2½	1½	9	½	needle	no
	SUBURBAN 26	$350	rotary	26	45	27	285	3	1½	11	½	sleeve	no
GALE	LAWN BOY 9275	$275	rotary	21	84	27	304	3½	1½	2	1	needle	no
	LAWN BOY 9245	$295	rotary	24	84	27	306	3½	1½	2	1	needle	no
GILSON	967	$240	rotary	25	49½	27	248	3	1½	12	1½	ball	yes
	966	$260	rotary	25	49½	27	250	3½	1½	12	1½	ball	yes
	965	$300	rotary	25	49½	27	260	3½	1½	12	1½	ball	yes
HOMELITE	YARD TRAC YTD-5	$400	rotary	26	51¼	27½	268	3½	1½	10¼	½	ball	yes
HUFFMAN	DIAMOND 4442	$130	rotary	24	43	27½	134	2¾	2	8	1	sleeve	no
	DIAMOND 4443	$170	rotary	24	43	27½	148	3	2¾	8½	1	sleeve	no
	BROADLAWN 4455	$300	rotary	25	48½	29¼	200	3½	1¾	10	1	sleeve	yes
JACOBSEN	JAVELIN	$450	rotary	26	40	28	n.s.	3½	1½	10	¾	roller	no
LAWNMASTER	301	$150	rotary	24	48	26	153	3	1	8¾	⅝	sleeve	yes
	306	$200	rotary	24	48	26	180	3	1½	9½	⅝	sleeve	yes
LOCKE	DEVERE-LOCKE 32R	$715	rotary	32	60	36	605	4	1	15	1	ball	no
MASSEY-FERGUSON	MF24 STANDARD	$210	rotary	24	48	26	164	3	1	9	½	sleeve	yes
	MF24 DELUXE	$290	rotary	24	48	26	210	3	1	9	½	sleeve	yes
McDONOUGH	SNAPPER COMET 304R	$370	rotary	30	59	34	310	4	1	10	½	ball	yes
	SNAPPER COMET 306RD	$420	rotary	30	59	34	322	4	1	10	½	ball	yes
MONTGOMERY WARD	GARDEN MART 41	$ 95	rotary	24	46	26	143	2¾	1¾	8	½	needle	no
	GARDEN MART 43	$165	rotary	24	46	26	166	2½	1½	10	½	needle	no
	GARDEN MART 47	$210	rotary	24	46	26	181	2½	1½	10	½	needle	yes
MOTO-MOWER	302	$200	rotary	24	48	26	177	3	1	8¾	⅝	sleeve	yes
	308	$280	rotary	24	48	26	208	3	1	9½	⅝	sleeve	yes
	305	$390	rotary	26	60	27	270	4	1½	18	½	needle	yes
MTD	LAWN FLITE 135-330	$140	rotary	24	45½	26½	148	2¾	1¾	14	½	ball	no
	LAWN FLITE 135-340	$180	rotary	24	45½	26½	175	3¼	1¾	14	½	ball	no
	LAWN FLITE 135-360	$215	rotary	24	45½	26½	185	3¼	1¾	14	½	ball	no
	LAWN FLITE 135-380	$275	rotary	24	50	27	235	3	1¾	14	½	ball	yes
J. C. PENNEY	PENNCRAFT 1415	$175	rotary	24	43	24	186	3	2	10	1	sleeve	no
	PENNCRAFT 1435	$240	rotary	25	47	24	195	3	1¾	10	1	sleeve	no
	PENNCRAFT 1445	$310	rotary	25	48	30	245	3	1¾	10	2	sleeve	yes
PENNSYLVANIA	4224-C	$225	reel	24	50	34	250	2	¾	40	5	roller	yes
	88-1	$400	rotary	30	57	33	380	3½	1½	15	1½	ball	yes
	88-2	$400	reel	30	57	35	375	2½	1	16	2, 3	roller	yes
QUICK	SPRINGFIELD LT425	$260	rotary	25	48	26	201	3	1½	10	½	ball	yes
	SPRINGFIELD LT525	$380	rotary	25	46	26	249	3½	1½	10	½	ball	yes
RUGG	5015	$100	rotary	24	47	27	132	2½	1½	10	½	needle	yes
	5025	$160	rotary	24	47	27	170	3	1¾	10	½	needle	yes
	5035	$190	rotary	25	47	27	181	3	1¾	10	½	needle	yes
	5045	$200	rotary	25	47	27	195	3⅛	1¾	10	½	needle	yes
	5065	$300	rotary	26	49	28	245	3½	1¾	12	1½	needle	yes
SEARS, ROEBUCK	CRAFTSMAN 807	$150	rotary	24	48	27	145	3¼	1¾	10	½	ball and needle	yes
	CRAFTSMAN 826	$270	rotary	26	55	31	210	3¼	1¾	12	⅜	ball and needle	yes
SIMPLICITY	WONDER BOY 400	$275	rotary	24	60½	27⅛	218	2⅝	1½	12	⅝	ball	no
	WONDER BOY SPECIAL	$350	rotary	32	62½	29½	270	3	1¼	12	⅝	ball	yes
	WONDER BOY SUPER	$370	rotary	32	62½	29½	275	3	1¼	12	⅝	ball	yes
SOUTHLAND	RR-245	$160	rotary	24	48	26	160	3	1	10	1	ball	no
	RR-255	$280	rotary	25	50	30	220	3	1	12	1	ball	yes
SWISHER	RIDE KING 32	$310	rotary	32	51	32½	210	3½	1¾	18	¼	ball	yes
TORO	BIG RED 25	$410	rotary	25	61½	25	266	3	1½	1	⅝	ball	yes
	BIG RED 34	$450	rotary	34	61½	40	272	3	1½	2¾	⅝	ball	yes
WESTERN AUTO	WIZARD 3542	$125	rotary	24	45½	26½	148	2¾	1¾	10½	1	n.s.	no
	WIZARD 3544	$165	rotary	24	45½	26½	179	3½	1	12	1	ball	no
	WIZARD 3545	$205	rotary	25	47	30½	215	2¾	1¾	12	½	ball	yes
	WIZARD 3552	$245	rotary	25	50	27	220	3	1½	12	1	ball	yes
	WIZARD 3555	$295	rotary	25	47¼	30½	235	3½	1	12	½	ball	yes
	WIZARD 3558	$350	rotary	25	46	28	249	3½	1½	8	¾	ball	yes
WHEEL HORSE	REO 65R	$400	rotary	32	56	33½	245	3⅜	1⅛	18	¾	ball and needle	yes

n.s.—Not specified.

Urheberrechtlich geschütztes Material

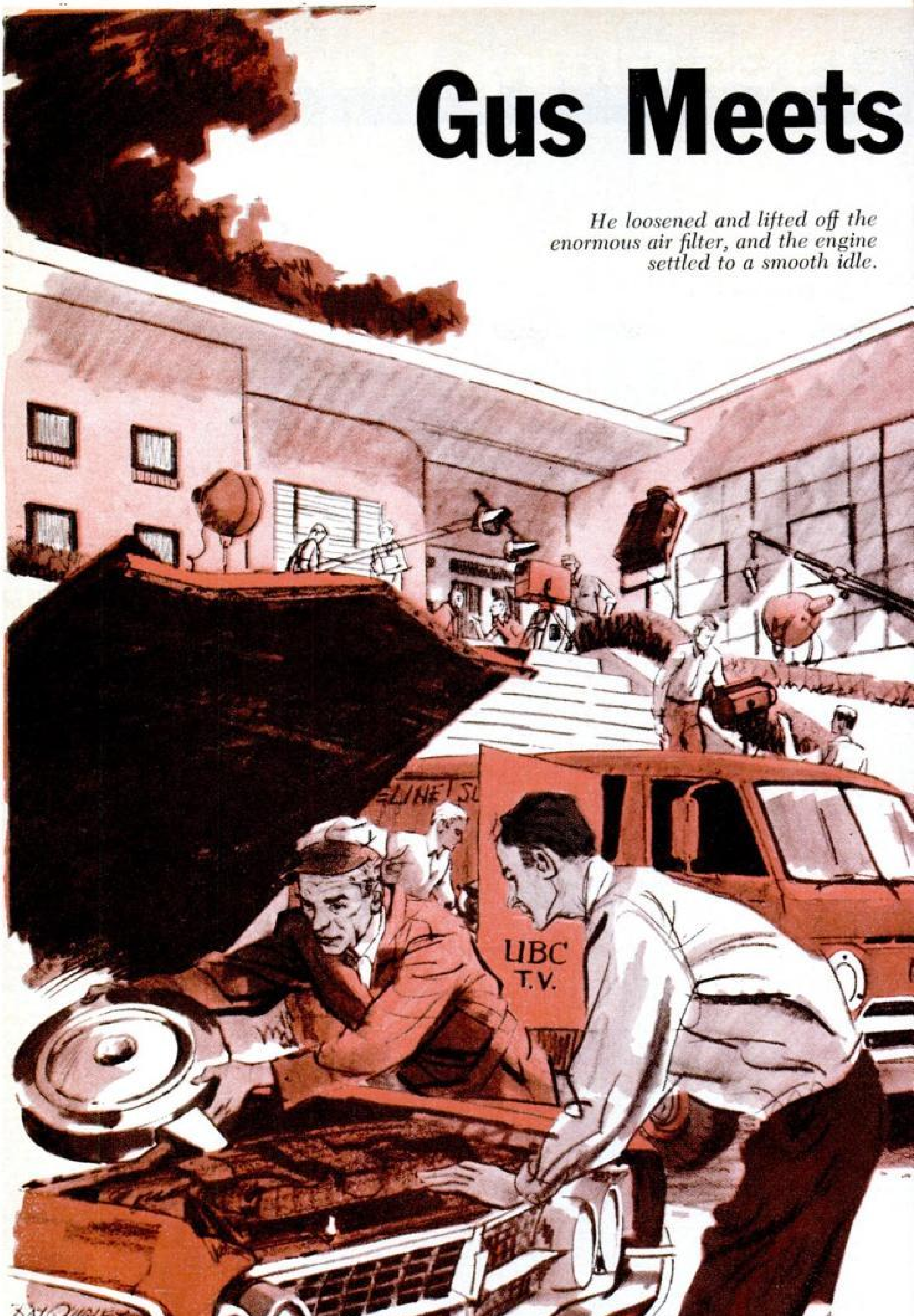
1965 Riding Mowers

MAKE OF ENGINE	HORSEPOWER (hp./r.p.m.)	TYPE OF MAINSHAFT BEARING	TYPE OF DRIVE TO WHEELS	TYPE OF CLUTCH	TYPE OF DIFFERENTIAL	NUMBER OF SPEEDS		TIRE DIAMETER (inches)		TYPE OF STEERING
						FORWARD	REVERSE	FRONT	REAR	
Briggs and Stratton	4/3,600	sleeve	chain	n.s.	automotive	2	2	8	10	handlebars
Briggs and Stratton	6/3,600	sleeve	chain	n.s.	automotive	4	1	11	16	handlebars
Briggs and Stratton	4/3,600	sleeve	chain	belt idler	automotive	2	2	10	12	tiller
Briggs and Stratton	3/3,600	sleeve	chain	none	none	1	1	8	10	tiller
Briggs and Stratton	4/3,600	sleeve	chain	belt idler	none	1	1	10	12	full wheel
Briggs and Stratton	4/3,600	sleeve	chain	belt idler	automotive	1	1	10	12	full wheel
Tecumseh	6/3,600	sleeve	chain	belt idler	automotive	2	2	10	13	full wheel
Briggs and Stratton	4/3,600	sleeve	gear	belt idler	automotive	variable	variable	8	10	handlebars
Briggs and Stratton	5/3,600	sleeve	gear	belt idler	automotive	variable	variable	10	12	handlebars
Lawn Boy	3½/2,500	needles	gear	disk	gear	3	1	8	10	tiller
Lawn Boy	3½/2,500	needles	gear	disk	gear	3	1	8	10	tiller
Briggs and Stratton	4/3,600	sleeve	chain	belt idler	automotive	1	1	10	12	tiller
Briggs and Stratton	4/3,600	sleeve	chain	belt idler	automotive	1	1	10	12	tiller
Lauson	5/3,600	sleeve	chain	belt idler	automotive	1	1	10	12	half wheel
Lauson	5/3,600	sleeve	chain	disk	belt	4	1	10	16	tiller
Briggs and Stratton	3/2,600	sleeve	chain	belt idler	none	1	1	8	10	handlebars
Briggs and Stratton	4/3,200	sleeve	chain	belt idler	none	1	1	8	10	full wheel
Briggs and Stratton	5/3,200	sleeve	chain	belt idler	automotive	3	1	11	15	full wheel
Tecumseh	6/3,600	sleeve	chain	belt idler	belt	variable	1	12	13	handlebars
Briggs and Stratton	4/3,600	sleeve	chain	belt idler	automotive	3	1	8	10	tiller
Briggs and Stratton	4/3,600	sleeve	chain	belt idler	automotive	3	1	10	10	full wheel
Wisconsin	9/3,000	roller	chain	disk	automotive	variable	1	14	15	handlebars
Briggs and Stratton	4/3,600	sleeve	chain	belt idler	automotive	1	1	8	10	tiller
Briggs and Stratton	4/3,600	sleeve	chain	belt idler	automotive	3	2	10	10	full wheel
Briggs and Stratton	4/3,600	sleeve	gear	disk	automotive	5	1	10	17	full wheel
Briggs and Stratton	6/3,600	sleeve	gear	disk	automotive	5	1	12	17	full wheel
Powr-Kraft	3/3,600	sleeve	chain	belt idler	none	variable	1	8	10	tiller
Powr-Kraft	4/3,600	sleeve	chain	sliding jaw	none	variable	1	8	10	handlebars
Powr-Kraft	4/3,600	sleeve	chain	sliding jaw	automotive	variable	1	8	10	handlebars
Briggs and Stratton	4/3,600	sleeve	gear	belt idler	none	1	1	8	10	tiller
Briggs and Stratton	4/3,600	sleeve	gear	belt idler	automotive	3	1	8	10	full wheel
Tecumseh	5/3,600	sleeve	gear	disk	automotive	3	1	10	10	half wheel
Briggs and Stratton	4/3,600	sleeve	chain	belt idler	automotive	1	1	8¼	10¼	tiller
Briggs and Stratton	4/3,600	sleeve	chain	belt idler	automotive	1	1	8¼	10¼	tiller
Briggs and Stratton	4/3,600	sleeve	chain	belt idler	automotive	1	1	10¼	12½	tiller
Briggs and Stratton	4/3,600	sleeve	chain	belt idler	automotive	2	2	10¼	12½	tiller
Briggs and Stratton	4/3,600	sleeve	chain	belt idler	none	1	1	8	10¼	tiller
Briggs and Stratton	4/3,600	sleeve	chain	belt idler	automotive	3	1	10	12	full wheel
Tecumseh	6/3,600	sleeve	chain	belt idler	automotive	3	1	10	14	full wheel
Briggs and Stratton	3/3,600	sleeve	chain	belt idler	ratchet	1	none	8¼	11	tiller
Briggs and Stratton	6/3,600	sleeve	disk	disk	automotive	variable	1	12	16	half wheel
Briggs and Stratton	6/3,600	sleeve	disk	disk	automotive	variable	1	12	16	half wheel
Briggs and Stratton	4/3,600	sleeve	chain	belt idler	automotive	variable	variable	10	12	full wheel
Tecumseh	5/3,600	sleeve	gear	belt idler	automotive	3	1	10	12	full wheel
Clinton	3½/3,600	sleeve	chain	belt idler	none	1	1	8	10	tiller
Briggs and Stratton	4/3,600	sleeve	chain	belt idler	automotive	1	1	10	12	half wheel
Briggs and Stratton	4/3,600	sleeve	chain	belt idler	automotive	1	1	10	12	half wheel
Briggs and Stratton	4/3,600	sleeve	chain	belt idler	automotive	3	1	10	12	full wheel
Briggs and Stratton	6/3,600	sleeve	chain	belt idler	automotive	3	1	10	14	full wheel
Craftsman	3½/3,350	sleeve	chain	belt idler	none	variable	variable	8¼	9	tiller
Craftsman	6/3,400	sleeve	chain	belt idler	automotive	variable	variable	10¼	16½	tiller
Briggs and Stratton	4/3,600	sleeve	gear	belt idler	automotive	2	2	8	14	half wheel
Briggs and Stratton	6/3,600	sleeve	gear	belt idler	automotive	2	1	8	16	half wheel
Briggs and Stratton	6/3,600	sleeve	gear	belt idler	automotive	2	1	11	21	half wheel
Clinton	3½/3,600	sleeve	chain	belt idler	automotive	1	1	8	10	tiller
Briggs and Stratton	5/3,600	sleeve	chain	belt idler	automotive	2	2	10	12	full wheel
Lauson	6/3,600	sleeve	chain	belt idler	none	1	1	13	10	full wheel
Tecumseh	6/3,600	sleeve	chain	belt idler	automotive	4	1	12	16	half wheel
Tecumseh	6/3,600	sleeve	chain	belt idler	automotive	4	1	12	16	half wheel
Briggs and Stratton	3/3,400	sleeve	chain	belt idler	none	1	1	8¼	10¼	tiller
Briggs and Stratton	4/3,600	sleeve	chain	belt idler	none	1	1	8¼	10¼	tiller
Briggs and Stratton	4/3,600	sleeve	chain	belt idler	none	1	1	10	12	tiller
Briggs and Stratton	4/3,600	sleeve	chain	belt idler	automotive	2	1	10¼	12	tiller
Tecumseh	5/3,600	sleeve	chain	belt idler	automotive	2	1	10	13	half wheel
Tecumseh	5/3,600	sleeve	chain	belt idler	automotive	3	1	10	12	half wheel
Lauson	6/3,600	sleeve	gear	belt idler	automotive	2	2	10	12	full wheel

Urheberrechtlich geschütztes Material

Gus Meets

He loosened and lifted off the enormous air filter, and the engine settled to a smooth idle.



Urheberrechtlich geschütztes Material

a TV Deadline

The cameras couldn't start shooting till Gus finished trouble-shooting—and that bus engine was deader than a TV badman

By Martin Bunn

"EMERGENCY call, Boss," announced Stan as Gus Wilson entered the Model Garage one brisk spring morning.

"Okay. You take it," said Gus.

"Uh-uh. It was the principal of the new trade school, calling for a visiting VIP from the city. He said to ask you to come yourself."

Gus grunted, changed to working clothes, and in five minutes was on his way in the wrecker. Turning into the horseshoe driveway of the new Vocational Arts School, he stopped well back of the entrance, before which was a cluster of cars.

One of them was a panel truck, its side lettered: DATELINE SUBURBIA—UBC-TV. Several men were unloading cameras, lights, and booms. Cables littered the pavement. Among five nondescript cars was a 1963 Olds finished in dull gold. Its side panel bore the same legend as the truck, plus the line: J. FIELDING—DIRECTOR.

"Are you the garageman we called?" asked a reedy young man, who introduced himself as Robbins.

"I'm from the Model Garage," said Gus.

"But are you Gus Wilson? Mr. Fielding insists on having him."

"I'm Gus Wilson. What's the trouble?"

"It's not really trouble," confided the young man in a husky whisper. "Mr. Fielding's car doesn't run just right."

"They said it was an emergency."

"Oh, it is. Mr. Fielding's car must always be in top shape. He insists on it. This morning it stalled twice. It must be fixed. He may need it any moment."

A shadow fell between Gus and Robbins. The slender, middle-aged man who came up wore tweeds, dark sunglasses, and no hat—Mr. Fielding himself.

"The engine sounds as if it's about to fall apart," he told Robbins. "If you'd have it serviced by somebody besides your brother-in-law, we might get it done right."

"This is Mr. Wilson from the Model Garage," said Robbins.

Fielding turned to Gus. "Probably you'd prefer to work in your shop, but please see what you can do here."

Without waiting for a reply, he left.

"Well, let's hear it," said Gus.

Jumping into the Olds, Robbins fired it up. The engine's idle had a rolling lope. Again and again it seemed about to stall. Its vibration shook the car.

"At higher speeds it's smooth," explained Robbins. "But at every stoplight it runs like this. Mr. Fielding insists . . ."

"He should insist on a tune-up."

"It had a complete tune-up yesterday," said Robbins. "I have the bill right here. Look at all they did."

Gus scanned the yellow sheet, which charged for new points, retiming, new plugs, oil and fuel filters, an oil change, cleaning the air filter, and a new condenser. The total came to a third more than Gus would have charged, but what interested him most was something not listed.

He loosened and lifted off the enormous air filter, detaching a tube. The engine settled to a smooth idle.

"It's not my brother-in-law," muttered Robbins. "My uncle owns the agency."

"Tell your uncle a tune-up should include servicing the PCV valve," said Gus, shutting off the engine.

"PCV? What's that?"

"Positive crankcase ventilation. This is the valve, on the right-hand valve cover. On this car it has two hoses. One dumps blow-by—combustion gases that get by the pistons into the crankcase—into the air cleaner. The other routes them to the intake manifold. The valve shifts from one to the other according to engine load. But if it's clogged it can't, and then those blow-by

CONTINUED

Urheberrechtlich geschütztes Material

gases will upset the carburetor mixture."

Robbins looked puzzled.

"PCV's been around since 1963," continued Gus. "Earlier in California. Some mechanics like to pretend it doesn't exist. It reduces air pollution. Instead of getting into the atmosphere, blow-by is sent back into the cylinders and burned. The engine can handle it, so long as it's metered right.

"But you can't dump blow-by in any time, in any amount, and have a smooth engine. A lot of cars have blow-by colic—or worse—because their PCV systems aren't maintained. A badly clogged one can build up enough crankcase pressure to blow main-bearing seals."

Detaching the PCV valve and air-breather cap, Gus soaked both in kerosene.

"It's possible to clean this valve," he told Robbins. "Some others are throwaways."

"How could they let the car go out, running as it did?" asked Robbins.

"Guess they adjusted the carburetor with the air cleaner off," said Gus. "It's so big you can hardly reach the screws when it's on. The idling mixture was right—until they put back the air cleaner and its PCV connection. Then the clogged valve sent blow-by above the carburetor. Since that's largely fuel-air mix that got by the rings, it enriched the normal mixture enough to cause surging and roughness."

"Robbins!" called a distant voice, to be echoed immediately by one nearer by: "Mr. Fielding wants Mr. Robbins."

The young man scurried off as if singed. Gus packed his tool kit, and was walking to the wrecker when Robbins stopped him.

"Please wait. Mr. Fielding's coming."

The director strode up importantly. "You may be able to help us further, if you will, Mr. Wilson," he said. "We are filming a documentary about this school and its part in the war on poverty and delinquency. Certain boys with aptitude for training are being sent here from the Mill City School. I wanted to picture their arrival in the Mill City School's bus, and record their reactions to the opportunity offered them here.

"But the bus driver has just phoned that the bus is stalled eight miles away, on route 118. A service-station mechanic he called couldn't get it running. Would you try to get that bus here in time?"

Gus considered. He knew what the Mill City boys were like—volatile, often troublesome, quick to believe nobody cared about them. Even if he failed, they would be better off for seeing somebody try to help.

"I'll go right out," Gus said.

"Good. Put the charges on my bill."

Gus spotted the bus—really a big station wagon with the school name on it—from the top of a long hill. It was near the bottom, as if it had started up and become discouraged. The driver had let it roll back onto the shoulder, where it stood slightly askew, two wheels blocked.

A ragged cheer went up from the boys inside as Gus swung around behind the bus. Young faces peered at him curiously. Two boys lounged against a fender, smoking. The driver, a sandy-haired little man with a drooping mustache, approached Gus. Even when he smiled a welcome, he continued to have a sad-eyed look.

"Sure glad you're here. Might keep them young hyenas quiet for a bit. Not that I blame 'em much—they're crool disappointed. They'd choke before admitting it, but they sure want to be on TV."

"Bet he's out of gas, mister," yelled one of the boys, but failed to get a rise out of the bus driver.

"What did that mechanic do before he gave up?" asked Gus.

"Not much. Said it wasn't getting gas and the fuel pump must be shot. But I put a brand-new one on a couple of weeks ago. Ran okay since, but it hasn't had much pep the last few days."

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Urheberrechtlich geschütztes Material

How did the new Buick Gran Sports win Cars Magazine's "Performance Cars of the Year" Award?

Handsomely. Very handsomely.

You don't win an award like that with wishy-washy cars. You don't win it with cars that are nothing more than handsome, comfortable and luxurious, either. Which is why Buick's Gran Sports—Riviera and Skylark—have a secret weapon under their hoods: Wildcat V-8 performance. Very sudden performance hooked to the sweetest handling, smoothest riding cars that ever came off a Buick line. And that's going some. *Cars* Magazine's award-givers saw it the first time they turned a GS on. Give a Riviera GS or a Skylark GS a try yourself, sometime soon. You may be inventing an award of your own.

The new Gran Sports from Buick

You don't need rally numbers on the side to impress people.

BUICK MOTOR DIVISION

Urheberrechtlich geschütztes Material

Gus removed the air filter. On cranking the engine, he could see no gas entering the venturi, nor detect the pungent smell of fresh fuel. Detaching the neoprene line from the delivery side of the fuel pump, he cranked again. No gas came out. But the fuel pump indeed looked new. So did the flexible hose leading to its inlet.

"Did they put on this new gas hose when they changed the pump?" Gus asked.

The driver chewed his mustache. "Yep, I recall that they did. The old one was cracked."

Gus squeezed the foot-long piece of tubing, then did the same with the neoprene line between filter and carburetor. Though old and oil-stained, it was firm. The hose back of the fuel pump felt flabby by comparison. Gus slipped it off. It dangled from his fingers, limp as overboiled spaghetti—and somehow familiar.

"Why didn't ya bring a horse?" inquired a loud voice from inside the bus.

"Go back to school—with us!" urged another boy.

"How about a tow?" called a third.

Ignoring these and sundry catcalls, Gus suddenly realized what was familiar. Going back to the wrecker, he hauled out a coil of bell-alarm hose—the kind laid in gas stations to signal the arrival of cars. The one at the Model Garage was so full of patches Gus had bought new hose to replace it.

He compared the hose to the piece taken from the bus. It was the same kind. Cutting off a length, Gus installed it in the bus and nodded to the driver.

The engine cranked with no result. A concerted groan swelled up inside the bus. Seemingly endless, the whir of the starter slowed ominously.

When the engine fired, the groans quickly turned into cheers.

Gus dropped the hood firmly in place. "Get going," he urged the driver. "But be sure you bring it to the shop today."

Early that afternoon the Mill City School bus rolled into the Model Garage, empty.

"Came because you told me to," said the driver. "But what for? She goes fine."

"She'd quit again," returned Gus. "I didn't fix it right. All I could do on the road was get you going." He brought out the clogged fuel hose. "See that? It's swollen shut inside. A little gas got through until you needed more to climb that hill. Then pump suction pulled in the walls and pinched it shut."

"Never saw a gas hose go bad so fast."

"This isn't the right kind. The mechanic probably didn't have it in stock, so he used a piece of bell-signal hose. But that's rubber, not neoprene, and gasoline swells and decomposes rubber."

The driver chewed his mustache. "You put on a new one, didn't you?"

"Sure—of the same signal hose, because I had it on the truck. Now I'm going to put on the right hose."

"Hey now, wait," muttered the driver as Gus opened the hood. He kept on talking while Gus removed the temporary hose and installed the new one.

"Sorry, I didn't hear all that," confessed Gus, closing the hood.

"Said I can't pay you. But I'll tell the school folk what you done, and you can send 'em a bill."

"It's all been paid," said Gus.

"You mean that?" asked the driver. "Then I won't have to make out a long-winded report to the superintendent. Sure it's okay? Who said so?"

Gus's voice sank to a whisper. "Mr. Fielding. In fact, he insists." ■ ■

Rolling bike rack speeds tunnel traffic

To keep bicycles from cluttering the roadways of the Dartford-Purfleet tunnel under the Thames near London, the authorities operate a shuttle service with a fleet of five buses solely for cyclists.

Bikes load from either side onto racks in the lower section of the specially built double-deckers; more can be carried in the tail. Riders make the one-mile trip in seats —and solid comfort—on the upper level.

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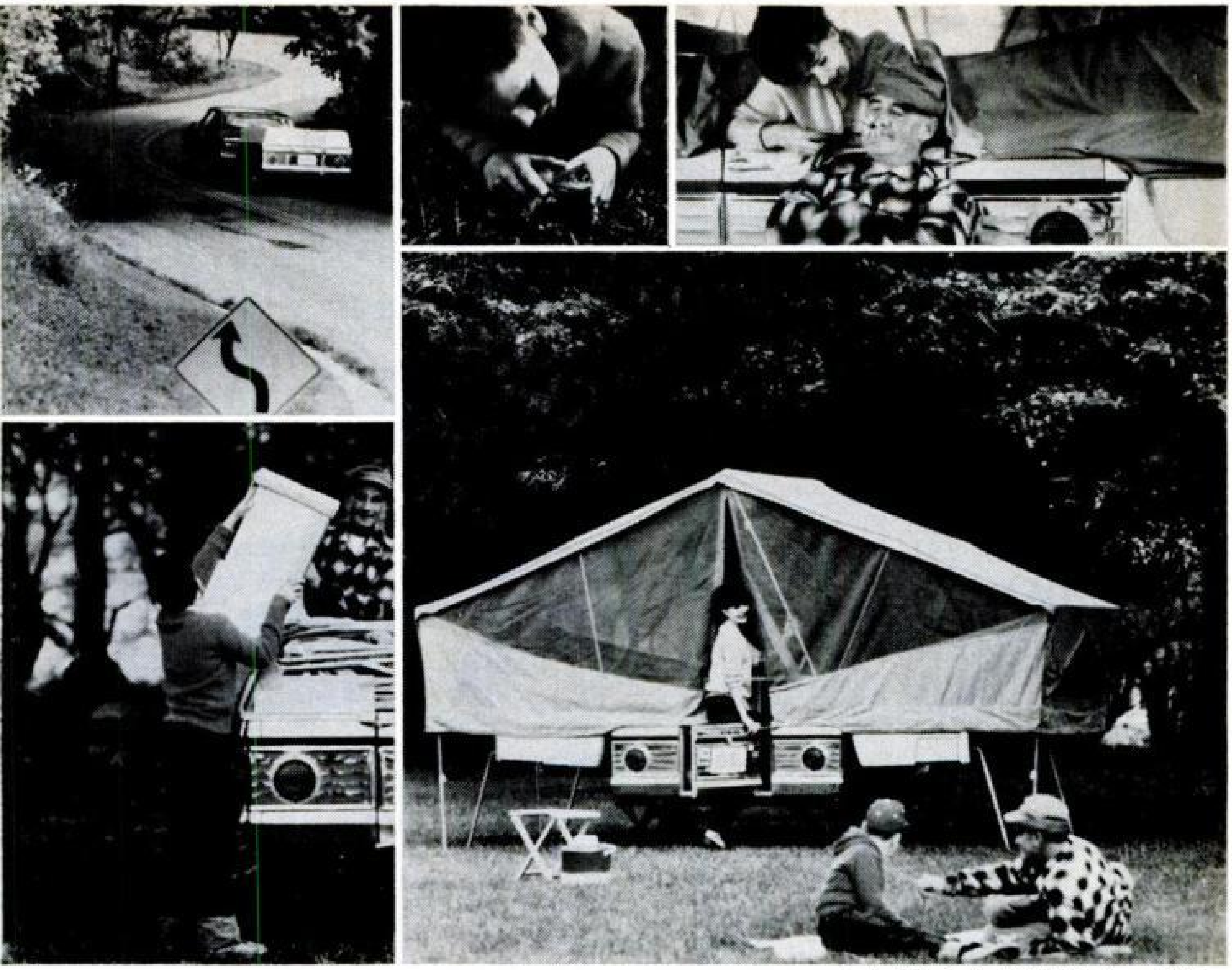

Apache Golden Eagle, $795.00 F.O.B., Lapeer, Michigan.

UNWIND IN AN APACHE

Apaches are built for relaxation. Plenty of room to move around in, plenty of space for storing things. It goes up in the time it takes to boil a pot of tea. You laze around on built-in double beds with foam mattresses. Everything's above ground (you can live off the land!). Big screened picture windows let in fresh air and beautiful view. Pre-shrunk, treated Army Duck tenting and zippered storm flaps keep out the elements. A lightweight aluminum Apache tows at normal highway speeds, with all your gear tucked neatly inside, not in the car. Locking ABS polymer hard cover makes it pilfer-proof. Relaxing price, too . . . Apache Camping Trailers start at as little as $445.00.

APACHE
CAMPING INFORMATION HEADQUARTERS

When traveling, stop at this sign for camping information. Apache dealers are ready, willing and able to assist you.

©Vesely Co. 1965

APACHE CAMPING TRAILERS

Send your name and address to Vesely Company, Lapeer, Mich., for free 1965 Apache brochure. Check the Yellow Pages for the name of your nearest Apache Camping Center.

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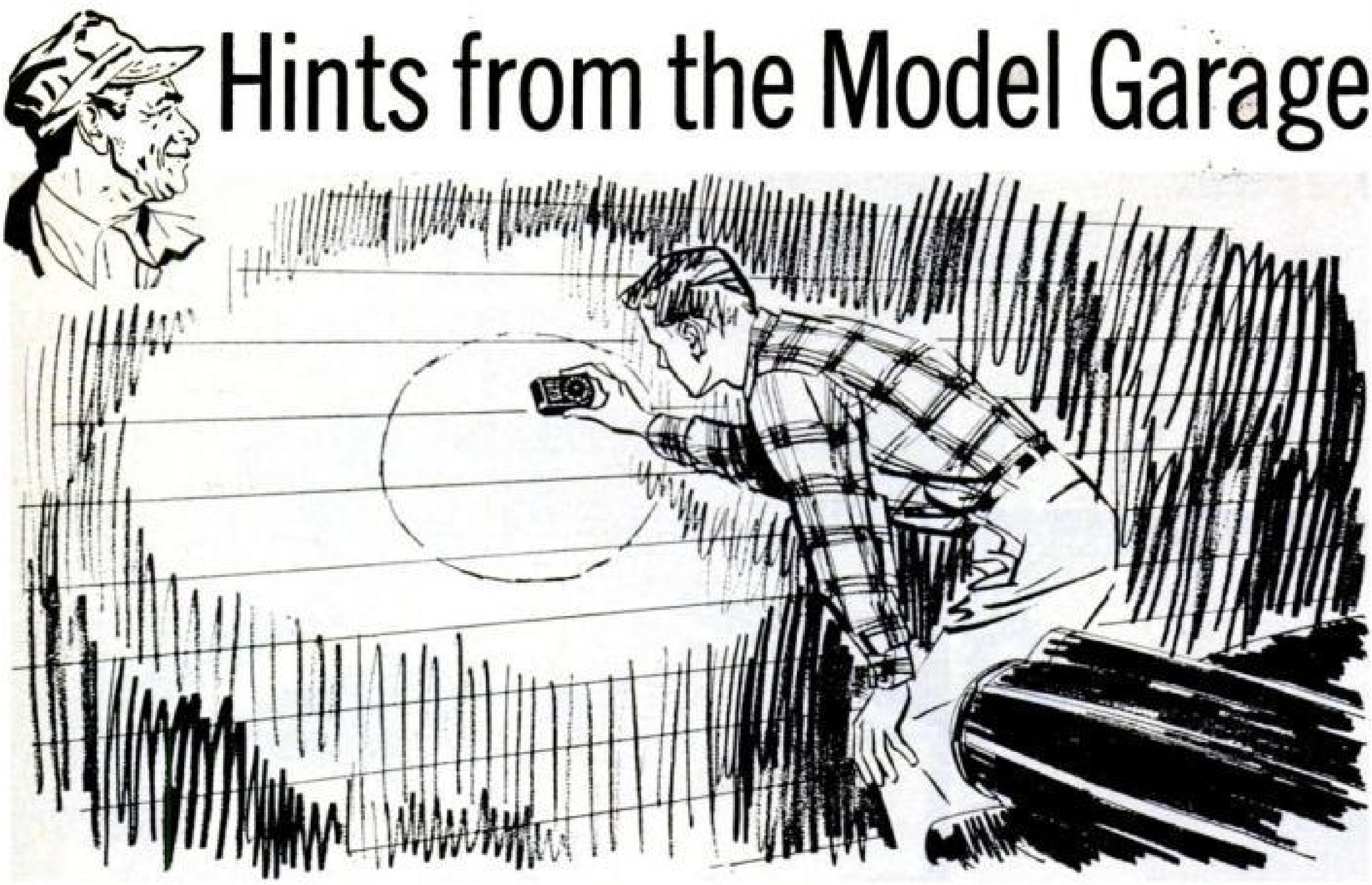
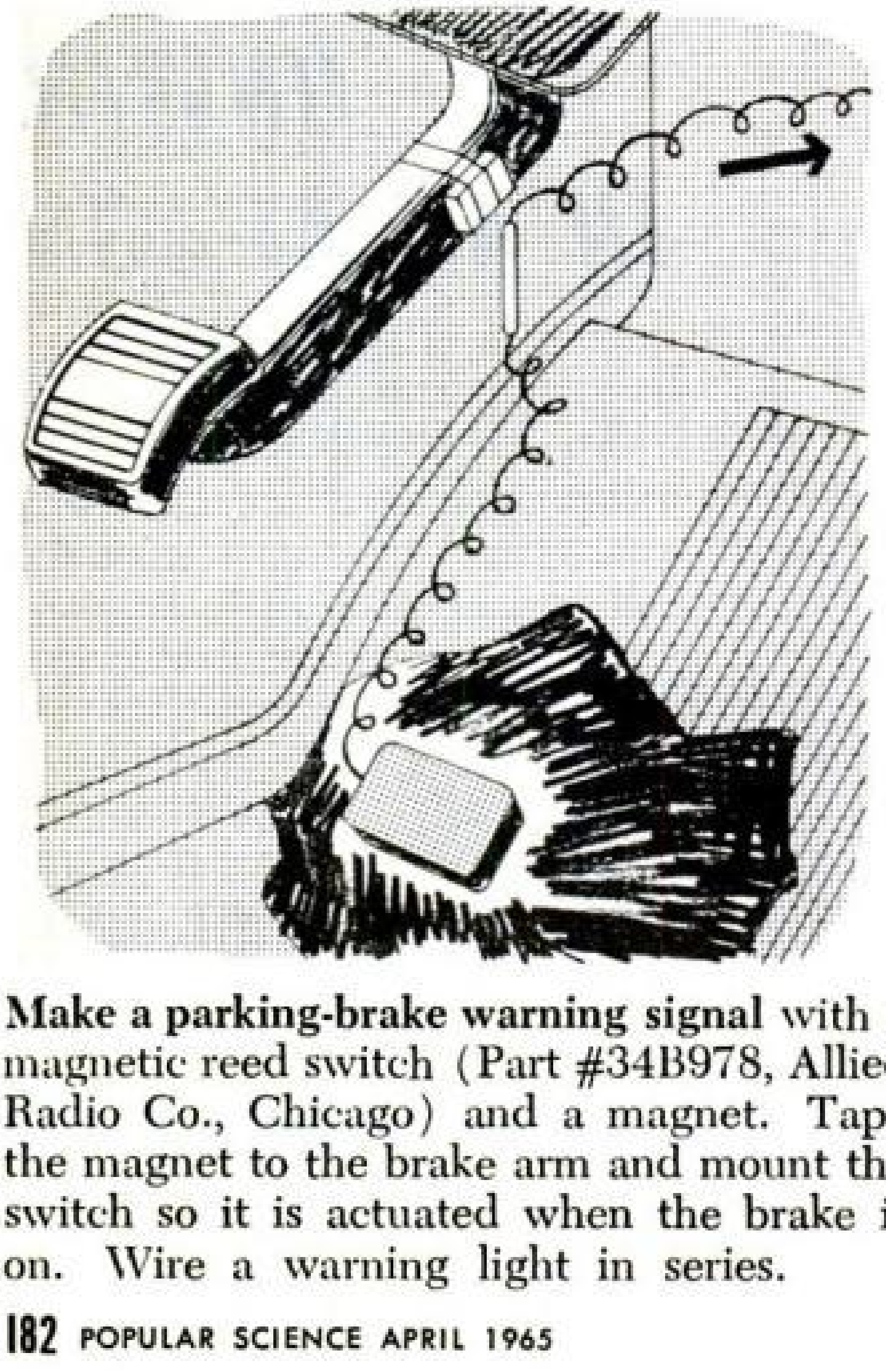
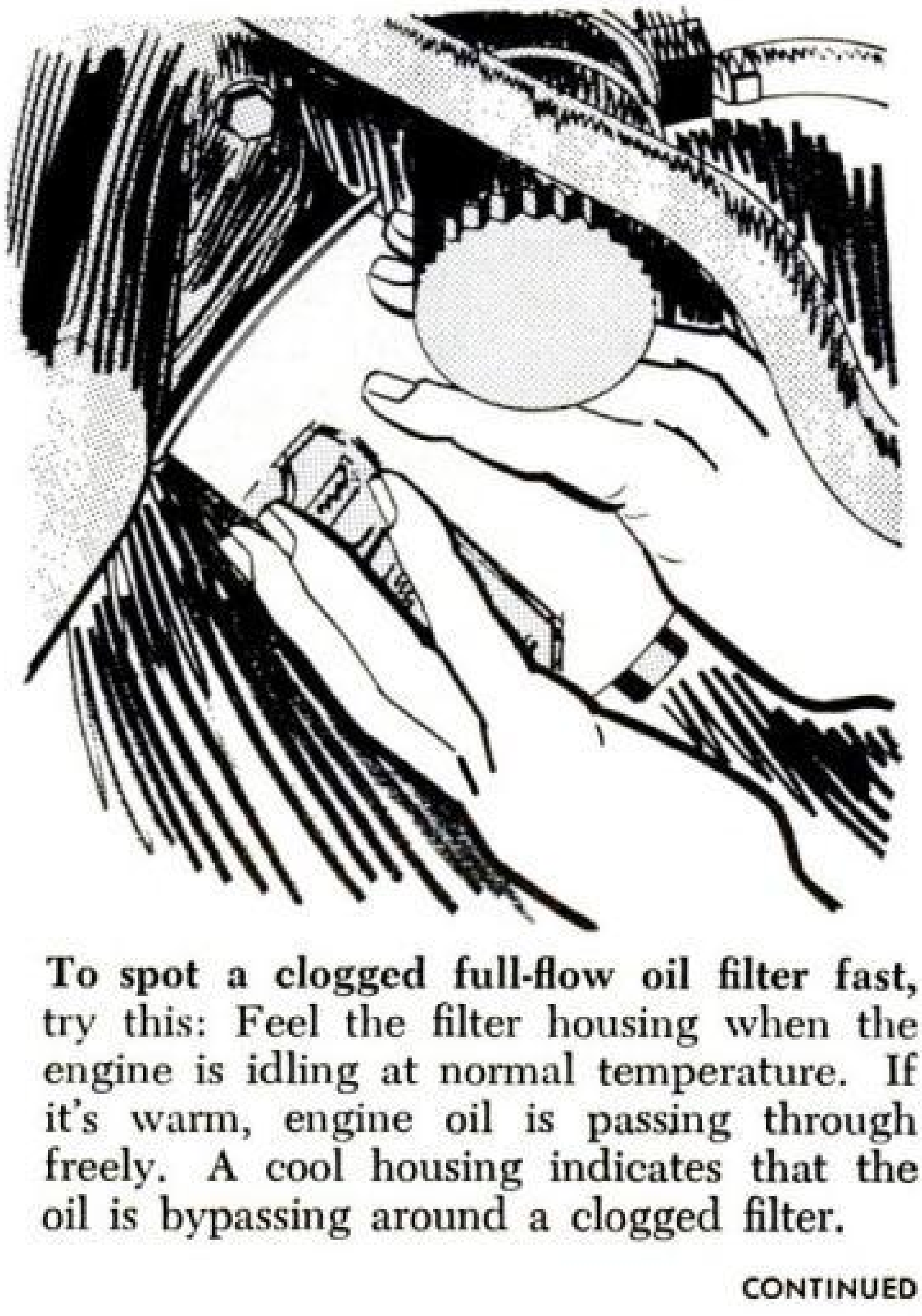
Hints from the Model Garage



For precise headlight alignment, use a photo exposure meter to find the beam's brightest spot. Set up an aiming target (see your car's service manual), and scan the headlight-beam pattern with the meter. When you locate the hot spot, align the headlight to center it on the target's aiming point. If the hot spot covers a broad area, mark its boundaries on the target, and measure to locate the center. Make sure you stand outside the beam when you take a reading, and hold the meter so it's not in shadow.



Make a parking-brake warning signal with a magnetic reed switch (Part #34B978, Allied Radio Co., Chicago) and a magnet. Tape the magnet to the brake arm and mount the switch so it is actuated when the brake is on. Wire a warning light in series.



To spot a clogged full-flow oil filter fast, try this: Feel the filter housing when the engine is idling at normal temperature. If it's warm, engine oil is passing through freely. A cool housing indicates that the oil is bypassing around a clogged filter.

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Urheberrechtlich geschütztes Material

Looking for a truly efficient big outboard, one that thrives in fresh or salt water and even shifts for itself?

This is it. The carefree, new 90 hp Golden Meteor II *(a Johnson, of course!)*

The new Golden Meteor II, with its new, straight-through induction system and 4-barrel carburetion, burns no more fuel than engines with significantly less horsepower.

Other members of the famous Johnson V-4 family include the two V-75 models (Electric and Electramatic) and the economical Electric V-60. Both the Electric V-75 and V-60 are available with a special high-thrust lower gear case for heavy loads.

Exclusive Electramatic Drive! This new electromagnetic transmission is standard equipment on the V-90, and on one V-75 and one 40. It shifts electrically, works automatically as you move the throttle forward or back—control comes with motor at no extra cost.

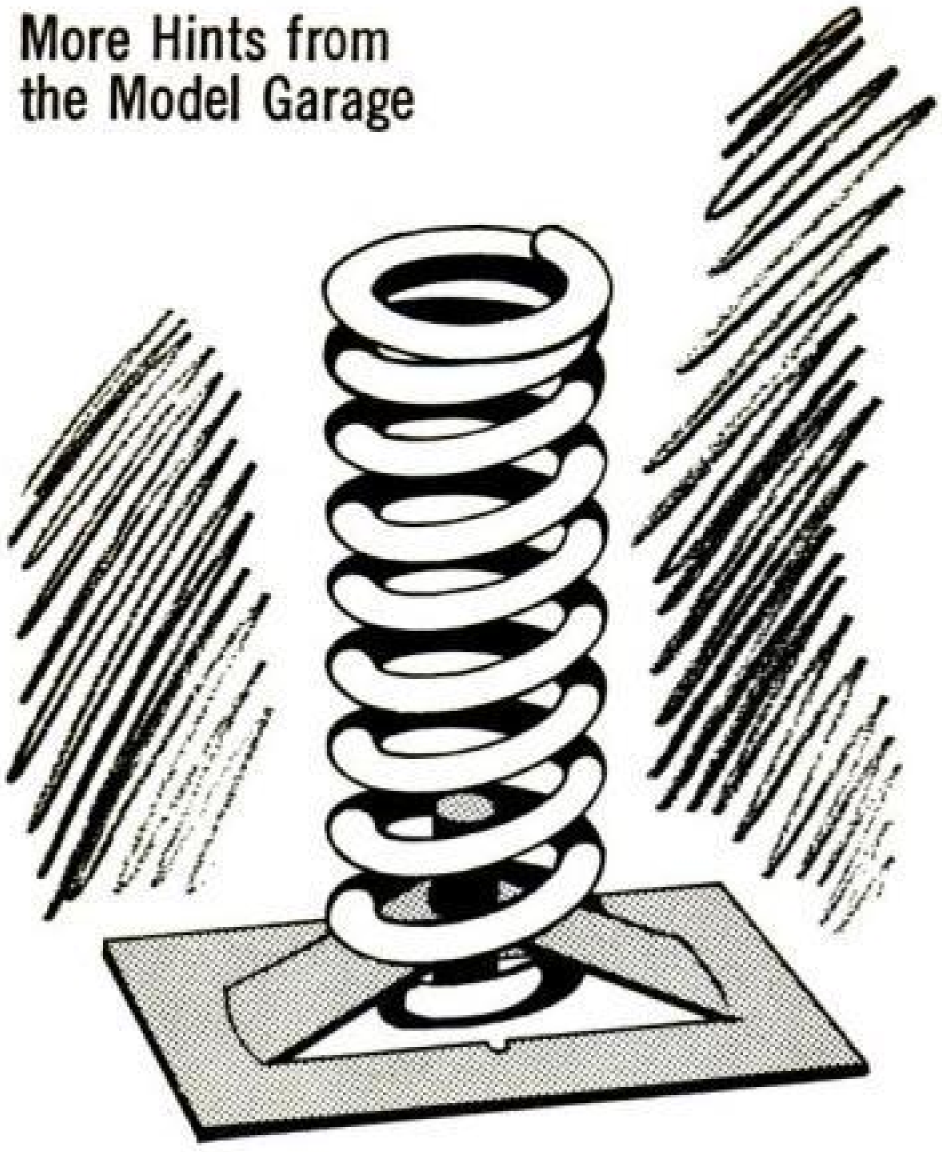
2-year warranty on every '65 Sea-Horse! All 17 new Johnsons, from 3 to 90 hp, are backed by a 2-year warranty*. All are quiet. All use a new 50:1 gas-oil mix to halve oil costs and lengthen engine life importantly. For the right engine to fit your needs, see your Johnson dealer. He's in the Yellow Pages. Johnson Motors, 1946 Pershing Rd., Waukegan, Ill. Div. Outboard Marine Corp. In Canada: Johnson Motors, Peterborough, Ont.

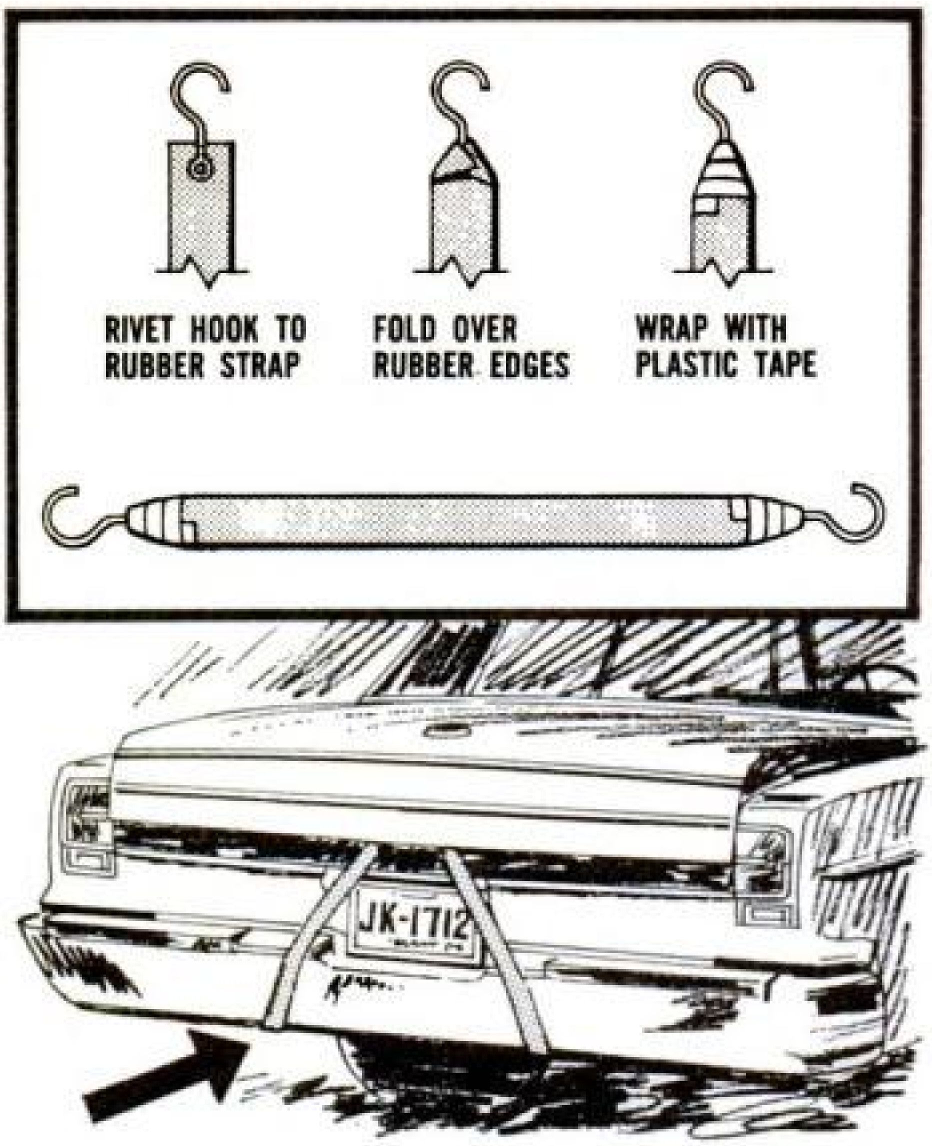
*For 24 months after purchase, Johnson will replace, without cost to the original purchaser, any part of its manufacture which upon inspection proves to have failed in normal use due to faulty material or workmanship.

Another carefree Johnson ... first in dependability

Urheberrechtlich geschütztes Material

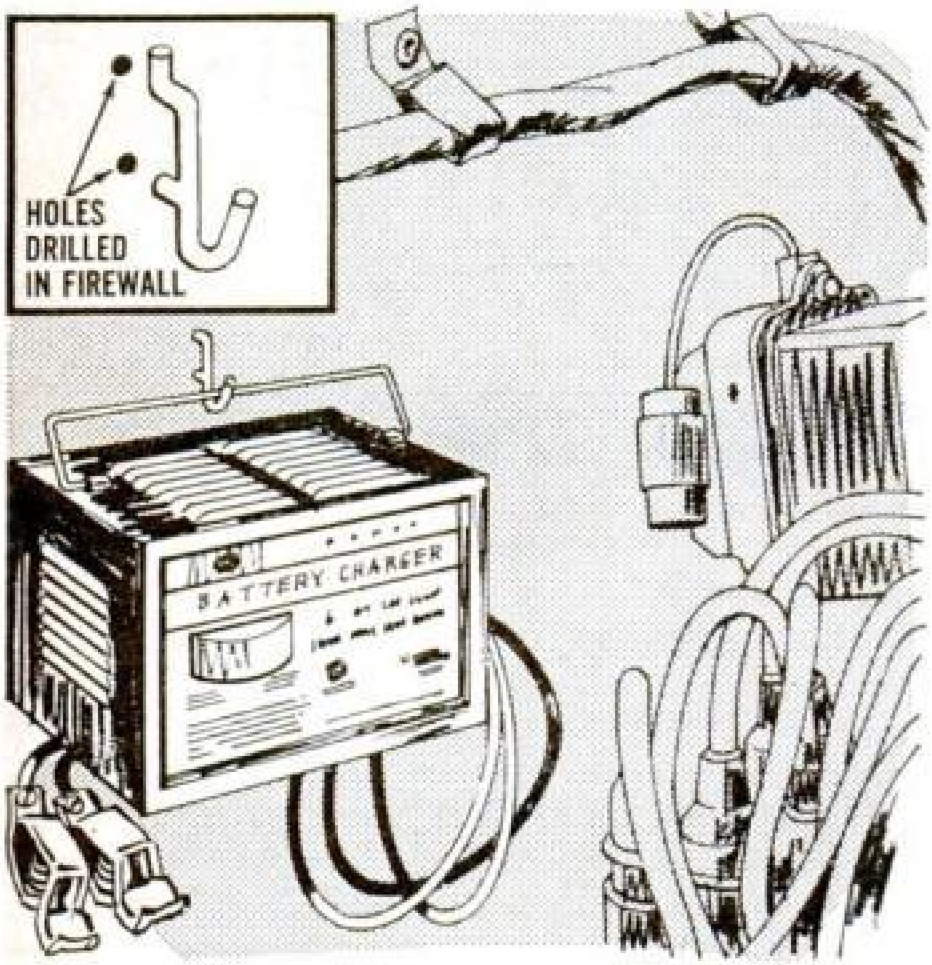
More Hints from the Model Garage





Tinnerman nuts are commonly used to fasten trim to body panels. Here's an easy way to remove a nut without damaging the stud: Twist an old clutch spring on the stud, as above, and pull upwards. The spring relaxes the bite of the nut's teeth.

Make a trunk-lid hold-down strap, for use with oversize loads, out of a rubber strip cut from an old inner tube. Rivet a steel hook to each end, and finish as shown above. Hint: Make up several straps of different sizes so you have one to fit any load.

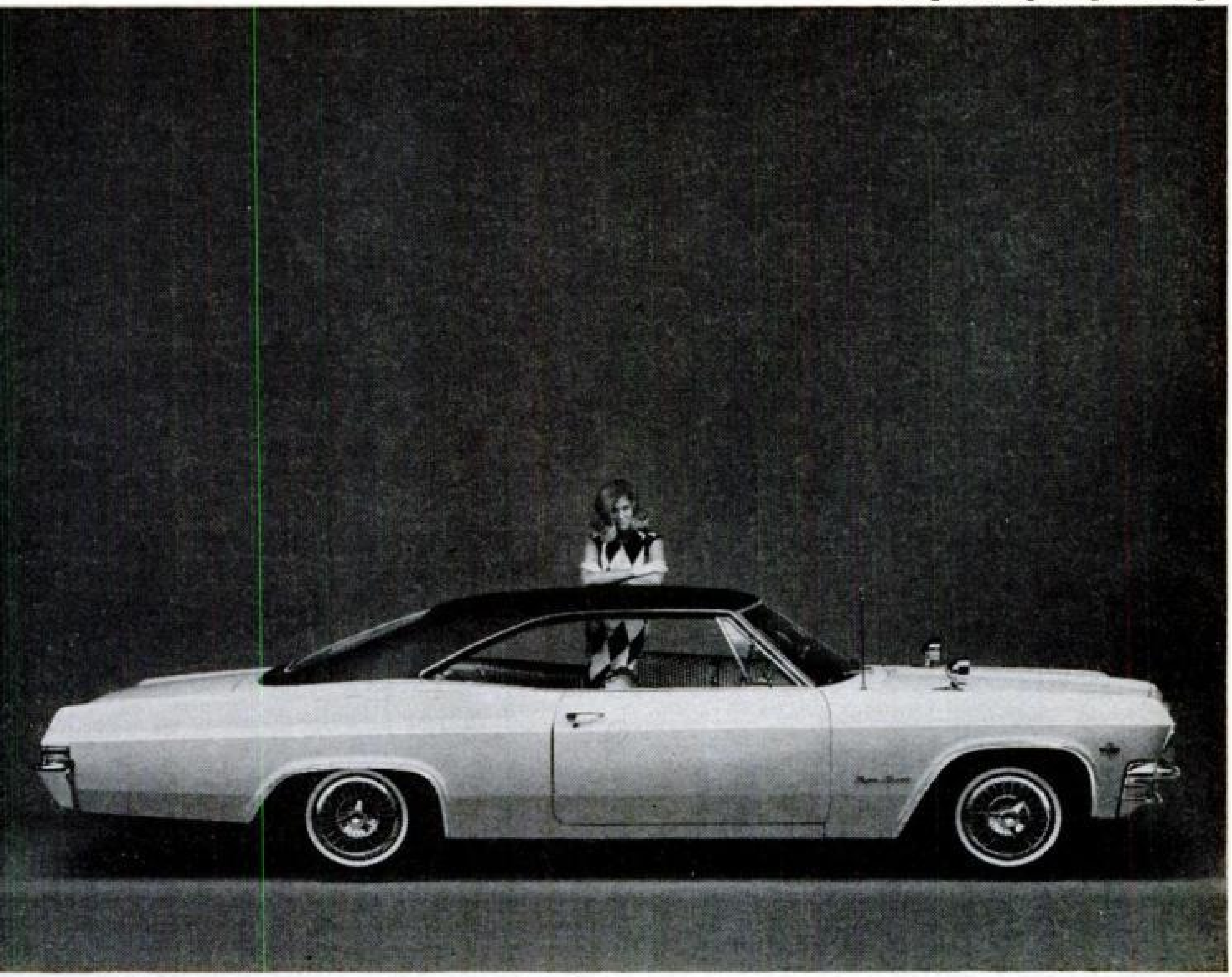


Hang your battery charger on a hook made by mounting a medium-size pegboard hook in your car firewall. Drill two 3/16" holes on 1" centers, and slip the hook in place. Besides being convenient, the charger gets sufficient ventilation to prevent overheating.

Keep your car from rolling off the jack when you change a tire with this pair of safety wedges. Make them by chaining together two 8" lengths of 1½" angle iron or tempered-aluminum angle. Place the wedges against the unjacked wheel on the lifted side.

Urheberrechtlich geschütztes Material

Impala Super Sport Coupe



A special Chevrolet we'll practically custom tailor for you

There are nearly 200 custom touches you can have us add to make this Impala Super Sport as unique and personal as you like.

There's an AM-FM Stereo radio you can add. Black vinyl roof cover. Tinted glass. Four-Season air conditioning. Seven-position Comfortilt steering wheel. Tachometer.

You combine all this with a Super Sport's front bucket seats, center console, all-vinyl interior and wall-to-wall deep-twist carpeting, and that's about as special as a car can be.

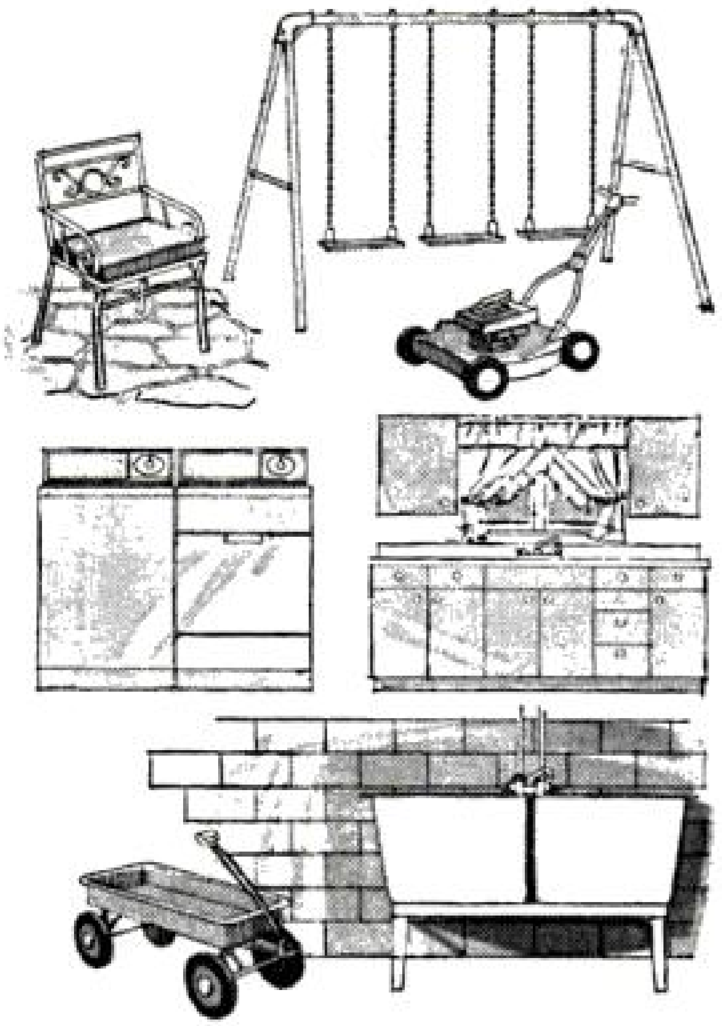
Your Chevrolet dealer has a book listing everything this Impala comes with and all the special touches you can add. He'll be [illegible] show it to you.

And remember, this is a custom-tailored *Chevrolet* we're talking about. So it's like ordering a suit from a wonderful little old tailor who hasn't heard what those shops with the fancy names are charging for the same thing. . . . Chevrolet Division of General Motors, Detroit, Michigan.

CHEVROLET

Urheberrechtlich geschütztes Material

Don't paint it...



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That New Flying Lawn Mower
[Continued from page 171]

about it. The mower doesn't run straight. This bothered me. I took a run down the center of the grass. When I looked back, the row was wobbly. It seemed untidy. A few minutes later, however, when I had finished the entire lawn, it looked neatly mowed. In a little while I got used to the nontracking nature of the Flymo, and now it doesn't bother me at all.

Another difference between this and other rotaries that you must get used to is the way it delivers clippings. A standard rotary blows clippings out of a chute and scatters them. With the Flymo, clippings fall to the ground beneath the housing. The result is a sort of flat 19-inch windrow, which makes the mower a great companion for a brush-type or vacuum yard sweeper. You vary the height of cut between $\frac{5}{8}$ and $1\frac{3}{8}$ inches by installing or removing bushings to raise or lower the blade.

The action of this new machine will change your whole mowing system. Since there is no longer any reason for mowing around and around (with regular machines, you blow the clippings to the outside, to avoid buildup) you'll find yourself mowing back-and-forth or on the diagonal. You'll work into a small area and stand there floating the mower back and forth merely by alternating lateral pressure on the handle. With each swing, you back up or move ahead a step. You're mowing crosswise. The profile is so low, you slip under shrubs with ease.

The no-wheels problem. One more disadvantage: The Flymo flies only when the engine is running. When it isn't—it skids. That means you can't roll it into the garage —or wherever you store your mower. You can run it across driveways or sidewalks, but when you shut it off, it is immobile. However, the whole thing weighs only 30 pounds, and is easy to carry. And you can hang it up by the handle on a spike with the housing flat against the wall—it sticks out only about 10 inches.

The Flymo was invented and first used in Sweden. The way the story goes, the inventor brought it to America and offered it under license to half a dozen mower manufacturers. They all turned the idea down as obviously preposterous. Toro is an outfit that thinks it's fun to do something offbeat now and then. So—look at the Flymo, at $74.95, and see if you don't like it.

'enneys Mail Order Sales Desks (cont'd)

OWN	TELEPHONE
IDIANA	
uth Bend	CE 4-6051
allivan	268-4301
oton	OS 5-7428
alparaiso	HO 2-4117
ncennes	TV 2-0032
abash	563-2174
ashington	CL 4-4635
nchester	4-6401
WA	
bia	932-5128
gona	295-3578
urlington	752-5466
rroll	3524
edar Rapids	366-2471
enterville	856-6333
ariton	774-2163
erokee	225-2516
nton	243-3602
s Moines	288-5741
buque	588-1401
ersville	875-7151
nmetsburg	852-2828
therville	362-3555
rt Dodge	576-3193
rt Madison	372-7553
innell	236-6171
undy Center	824-5466
warden	552-1423
a Grove	364-3396
fferson	386-4117
okuk	524-4864
Mars	546-4105
on	HI 6-4177
aquoketa	652-4931
arshalitown	752-4533
ason City	424-2612
ssouri Valley	2-2753
. Pleasant	385-3117
ew Hampton	394-4151
ewton	792-2900
lwein	283-1622
ceola	342-2136
kaloosa	673-8361
tumwa	682-8191
rry	465-4608
ck Rapids	472-2503
encer	262-4564
orm Lake	732-1300
nton	472-2382
shington	OL 3-5454
terloo	AD 4-4621
ukon	568-3473
verly	352-3235
ebster City	832-2291
nterset	462-4506
ICHIGAN	
ion	629-9131
egan	OR 3-6661
na	463-6161
ena	356-2216
n Arbor	761-1313
y City	TW 2-4501
Rapids	796-8687
dillac	775-3451
lumet	2740
ro	OS 3-3188
eboygan	627-5606
ldwater	278-4585
troit	
15240 Grand River Ave.	836-2830
19251 Mack Ave.	886-4400
canaba	786-5700
it	239-4623
dstone	425-2231
eenville	754-4685
stings	945-2435
lsdale	437-3338
lland	396-3503
n Mountain	774-2868
n River	265-9936
peming	486-9916
kson	782-0471
amazoo	381-2892
peer	664-8504
coln Park	382-7580
lington	843-5105
nistique	341-2151
rquette	225-1161

TOWN	TELEPHONE
Midland	631-1114
Monroe	242-4900
Mt. Pleasant	773-3631
Muskegon	726-4841
Owosso	723-5116
Petoskey	347-8777
Pontiac	338-4515
Royal Oak	549-7110
Saginaw	793-4511
Sault Ste. Marie	635-5291
St. Johns	224-3247
Sturgis	651-8585
Three Rivers	279-5151
Warren	755-1000
MINNESOTA	
Ada	784-3311
Alexandria	763-4194
Appleton	400
Bemidji	751-3143
Brainerd	829-8717
Crookston	281-4133
Detroit Lakes	847-9223
Duluth	
2010 W. Superior St.	727-8775
21 13th Avenue E.	724-8811
Ely	365-3205
Eveleth	741-2624
Faribault	334-3974
Grand Rapids	326-9611
Hibbing	262-3871
Jackson	847-4092
Litchfield	693-3248
Little Falls	632-9221
Luverne	283-2393
Minneapolis	336-5821
Montevideo	269-6558
New Ulm	354-8251
Ortonville	839-2592
Owatonna	451-3510
Pipestone	825-3338
Redwood Falls	637-2947
Rochester	288-2401
Roseau	634
St. Cloud	252-9000
St. James	375-3366
St. Paul	776-8541
Thief River Falls	681-1304
Tracy	629-4000
Virginia	749-1700
Wadena	631-2411
Wells	553-3131
West Duluth	628-2231
Wilmar	235-5502
Winona	8-4311
Worthington	376-2161
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Bethany	HA 5-7065
Boonville	TU 2-2781
Brookfield	CL 8-4404
Carrollton	LI 2-1642
Caruthersville	333-0123
Chillicothe	MI 6-1194
Columbia	GI 9-1221
Florissant	TE 8-7111
Fulton	642-6611
Hamilton	583-2153
Hannibal	AC 1-5600
Jefferson City	635-7111
Kirksville	MO 5-7731
Louisiana	SK 4-5503
Macon	EL 1-2161
Memphis	465-8547
Mexico	581-1983
Moberly	AM 3-6550
Poplar Bluff	SU 5-8456
Rolla	364-2122
Sikeston	471-0955
St. Louis	
2604 N. 14th St.	CE 1-4891
40 Town and Country Mall	HA 6-0720
2715 Cherokee St.	PR 1-8220
5930 Easton Avenue	CO 1-9777
Trenton	EL 9-2295
Washington	BE 9-4746
NEBRASKA	
Albion	395-2186
Fremont	727-1300
Neligh	887-4142

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Norfolk	371-0160
O'Neill	336-2868
Plainview	582-3427
Tekamah	650
West Point	372-2431
NORTH DAKOTA	
Carrington	652-3143
Fargo	237-9911
Grafton	352-2721
Grand Forks	772-6654
Harvey	324-2282
Langdon	256-2178
Lisbon	683-4127
Oakes	742-2157
Valley City	845-0770
Wahpeton	642-5538
OHIO	
Akron	
Wooster-Hawkins Plaza	836-0445
Arlington Plaza	773-3311
Lakemore Plaza Shop. Ctr.	733-8744
Alliance	823-4063
Ashtabula	997-5588
Bellevue	482-3201
Bowling Green	352-1611
Bucyrus	563-3060
Cambridge	439-1361
Canton	453-7721
Carrollton	627-2193
Celina	586-5125
Chillicothe	775-3388
Circleville	GR 4-7577
Cleveland	
6859 Pearl Road	842-3550
1435 S.O.M. Center Rd.	449-5800
Columbus	
647 Harrisburg Pike	276-5181
3776 E. Broad St.	237-0411
106 N. High St.	228-2991
3459 Cleveland Ave.	267-2551
Graceland Shop. Mart	267-2501
Great Western Shop. Mart	276-2685
Great Southern Shop. City	491-0671
Cuyahoga Falls	923-9701
Dayton	
100 E. Stroop Rd.	298-7337
4892 Airway Rd.	252-6531
Forest Park Plaza	278-7311
Defiance	783-4080
Dover	4-2318
East Liverpool	385-5440
Elyria	FA 3-5421
Findlay	422-7155
Fremont	332-1503
Galion	468-4444
Ironton	532-3954
Lancaster	653-3151
Lima	227-6075
Logan	EV 5-5611
Lorain	CH 4-6121
Mansfield	552-4590
Maple Heights	475-5000
Marietta	373-1500
Massillon	833-2681
Mentor	255-9311
Miamisburg	866-5931
Middletown	423-9213
North Olmsted	777-6500
Northfield	467-8191
Norwalk	668-4721
Parma	842-1855
Piqua	773-8944
Portsmouth	EL 4-2881
Salem	332-1577
Sandusky	625-2714
Springfield	324-5615
Toledo	
117 Main St.	693-0763
Southland Shop. Ctr.	385-6621
Miracle Mile Shop. Ctr.	472-1124
2604 Woodville Rd.	693-0781
Troy	332-1221
Van Wert	233-2010
Wapakoneta	738-2188
Washington Court House	335-4880
Xenia	372-8021

TOWN	TELEPHONE
Youngstown	
3367 Mahoning Ave.	799-1524
Boardman Shop. Plaza	758-9791
Liberty Plaza	759-2321
Zanesville	453-0735
PENNSYLVANIA	
Ambridge	266-8120
Baden	869-2171
Beaver Falls	846-7100
Bridgeville	221-3000
Donora	379-4620
Du Bois	371-5466
Ellwood City	752-1533
Franklin	437-3064
Greensburg	TE 4-7970
Greenville	588-4500
Indiana	463-8577
Jeannette	LA 3-5503
McKeesport	672-9755
Meadville	4-3271
Monessen	684-5772
Monroeville	372-4600
New Kensington	339-6671
Oil City	677-1217
Pittsburgh	655-3800
Punxsutawney	938-7300
Sharon	346-4141
Somerset	445-4151
Washington	225-9510
SOUTH DAKOTA	
Brookings	692-6305
Huron	352-6726
Milbank	432-4548
Mitchell	996-5646
Pierre	224-8666
Vermillion	624-2652
Watertown	886-8031
Winner	1006
Yankton	665-9628
WISCONSIN	
Antigo	623-4152
Appleton	RE 3-6601
Baraboo	EL 6-6614
Beaver Dam	TU 5-5538
Beloit	EM 5-5591
Clintonville	VA 3-2181
Columbus	623-3550
Eau Claire	834-3421
Fond du Lac	WA 2-7550
Fort Atkinson	JO 3-5581
Green Bay	435-5366
Hartford	673-3201
Janesville	PL 2-7401
Kenosha	OL 8-2301
Ladysmith	1100
Madison	
2323 Atwood Ave.	CH 9-2102
Westgate Shop. Ctr.	CE 8-2671
Manitowoc	682-8253
Marshfield	FU 7-1255
Milwaukee	
3425 W. North Ave.	444-5181
1135 W. Mitchell St.	383-5211
5566 N. 60th St.	464-0800
Monroe	325-5137
Neenah	PA 5-3081
New Richmond	246-6161
Oshkosh	BE 5-0560
Plymouth	TW 3-1921
Portage	RI 2-2183
Racine	ME 3-3563
Reedsburg	524-4377
Rice Lake	CE 4-8123
Richland Center	MI 7-6116
Shawano	LA 6-3117
Sheboygan	GL 8-4691
Sparta	272
Spooner	635-2195
Stevens Point	DI 1-0110
Superior	EX 2-8211
Two Rivers	793-1311
Viroqua	ME 7-3181
Watertown	261-3130
Waukesha	LI 2-9211
Waupun	324-5522
Wausau	845-4266
Wauwatosa	SP 1-5100
West Allis	GL 3-3020
West Bend	FE 4-9401
Wisconsin Rapids	HA 3-5300

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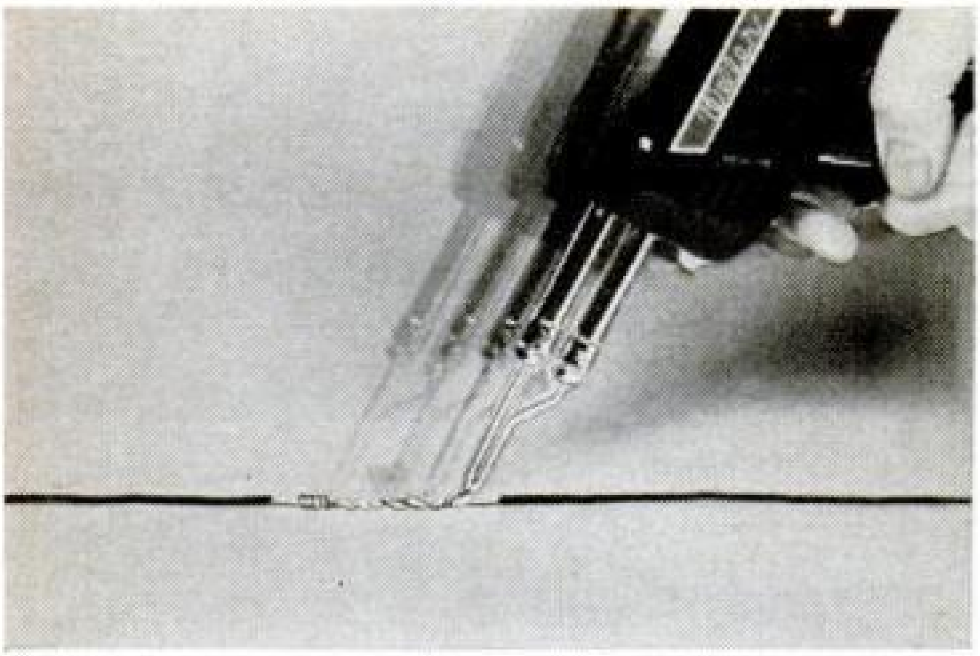
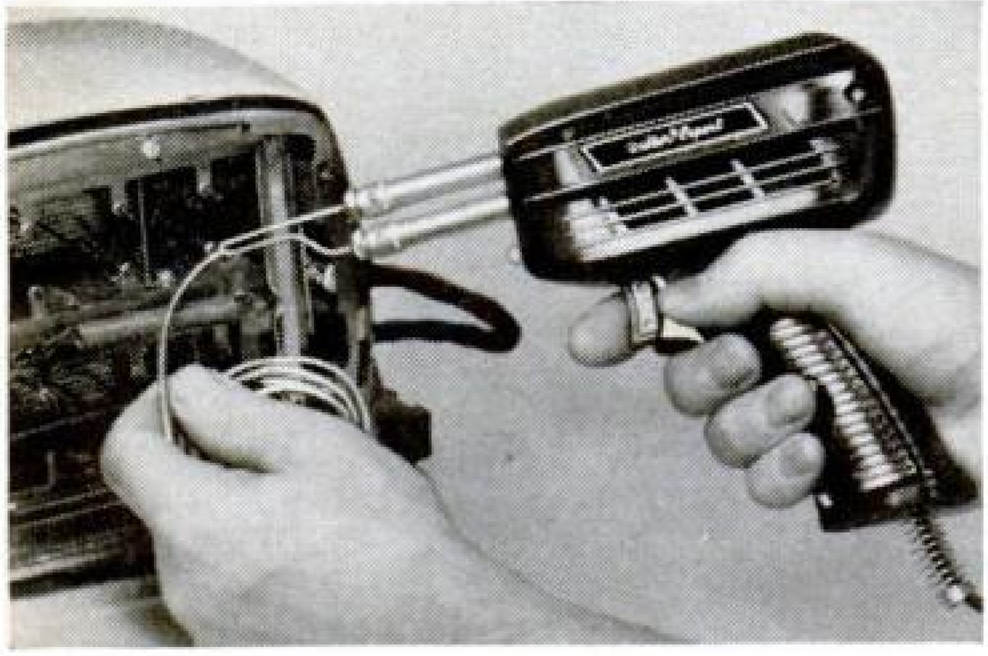
SOLDERING TIPS FOR ELECTRICAL REPAIRS



AVOID USING TOO MUCH SOLDER

Apply just enough solder to make a secure connection. Then slide the hot soldering tip away. The result is a smooth soldered joint.



USE PROFESSIONAL EQUIPMENT

The long-reach of a Weller Dual Heat Gun lets you solder in tight places. And a built-in spotlight lets you see where you're soldering.

Soldering is simple when you use a Weller Dual Heat Soldering Gun. Two trigger positions let you switch instantly to low 100 watt heat for electrical soldering or to high 140 watt heat for other household repairs.

Everything you need for fast soldering is included in a Weller Expert Soldering Kit. Dual heat gun, 3 soldering tips, tip-changing wrench, flux brush, soldering aid and solder —all in plastic utility case. Model 8200PK—$8.95. Weller Electric Corp., Easton, Pa.

Weller®

WORLD LEADER IN SOLDERING TECHNOLOGY

Straightening Out a Steering System

[Continued from page 143]

removes the load imposed on the worm bearings by the close meshing of ball-nut and sector teeth, and leaves only the worm-bearing preload, which can now be measured.

3. Turn wheel slowly in either direction until you reach the stops; then back up about one turn. Be careful: You can damage the internal parts if you force the steering wheel hard against its stops.

Using a utility scale, measure the pull required at the steering-wheel rim to keep the wheel in motion. This should be between ⅜ and ⅝ pounds.

4. To adjust worm bearings, loosen the lock nut and turn the worm-bearing adjuster to remove perceptible end play in the worm. Check pull at the wheel rim and readjust until the proper pull is obtained.

Any grittiness after bearing adjustment is a sign of bearing damage; it's time for an overhaul.

5. To set sector lash, first count the number of steering-wheel turns to go from lock to lock. Position the wheel ¼ of the way from either full right or left. Measure the pull required to swing the wheel through its center position. Turn the adjuster screw clockwise until the scale shows a pull between ⅞ and 1½ pounds. If the pull ever exceeds 1½ pounds, back out the adjuster screw and begin again.

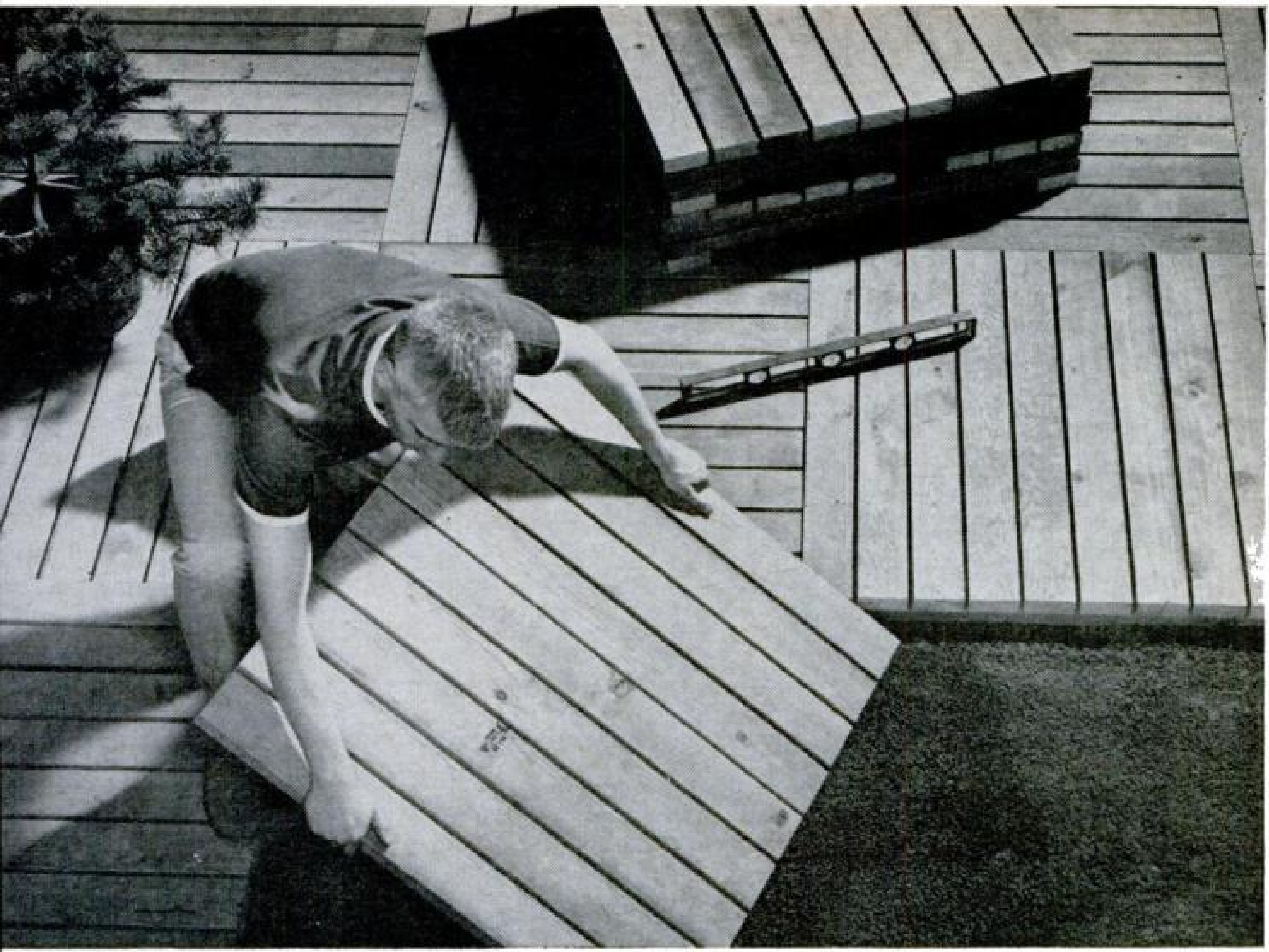
Servicing ball joints. Ball-joint front suspensions date back to 1952. In the early days, both upper and lower joints were spring loaded. A worn joint could be spotted by tugging a front wheel up and down: If there was noticeable looseness, the joint was bad.

In 1955 Chevrolet introduced nonloaded loose-type inverted lower ball joints, and this is when all the confusion about ball-joint wear began.

The upper joint in this arrangement carries no car weight. Its functions are to hold one end of the steering spindle in position, dampen the gyroscopic movements of the wheel and tire assembly, and supply a calculated amount of resistance to the steering system. It has a spring-loaded stud. Each lower joint carries half of front wheel weight; this keeps the ball firmly seated in its plastic-fiber socket. Wear is concentrated in an area about 45 degrees from the top of the ball and towards the wheel. The resulting side movement of a

CONTINUED

Urheberrechtlich geschütztes Material



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You can easily put one over a garage or driveway, off a second story, or one step off the ground. Just tell your dealer where you want to put it and how big you want to make it. Items you need for a 12′ x 12′ unit run less than $50. He'll put together a kit that'll include everything you need. Ask him for a booklet of decking ideas too. If he dosen't have one, mail us 10c and this coupon. We'll send you one.

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Good deal Tilling and cultivating is faster, easier than ever with new Simplicity SUPERMATIC Roticul! To its tireless 4 hp "go" is added an all-gear reverse with pushbutton fingertip control for greatly increased efficiency with very little effort. Roticul's scientific slow-speed tilling action crumbles toughest soils without damaging soil structure. Self-sharpening tines stand off punishment. Releasing handle grips automatically stops machine. Also available: 3 hp economy version Roticul.

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Your nearby Simplicity dealer is proud to stand behind the machines he sells—America's No. 1 line of power equipment for lawns and gardens. And he's anxious to help you gain *and maintain* peak performance, with dependable service. Ask about his convenient budget terms.

DO IT WITH Simplicity®

Simplicity Manufacturing Company
6544 Spring St., Port Washington, Wis.

worn joint makes it impossible to maintain wheel alignment.

The old-fashioned wear test won't work with nonloaded lower ball joints, since even a brand-new joint will feel loose when there is no weight on it. The correct test procedure includes a check of the upper (spring-loaded) joint for proper torque (resistance) and the lower joint for amount of wear. While the actual procedure will vary, the same approach is used for checking ball-joint suspension on all cars. Support car weight at outer end of lower control arm, and remove the wheel assembly.

Making the test. Remove cotter pin and nut from upper ball-joint stud and dislodge the stud from the spindle. Install the nut on the stud and measure torque required to turn the stud. This should be a minimum of two foot-pounds. If excessive wear is indicated by a lack of torque, both upper and lower joints should be replaced. The maximum allowable torque is 15 foot-pounds with the joint well lubricated. After the check, replace the stud in the spindle, torque the nut to 35-45 foot-pounds, and install a cotter pin.

Each lower joint should be inspected for wear only after both upper joints are found to be within limits.

Support the car weight on the wheels and use calipers to measure the distance from the top of the lower-joint grease fitting to the bottom end of the ball stud. Record the dimension for each side.

Next, support the car weight at the outer end of each lower control arm so that the wheels are free, and again measure the distance from the grease fitting to the stud end. If the difference between the two measurements in either set is greater than 3/32 inch, both lower joints should be replaced.

Idler arms. These are false pitman arms that move parallel to, and in the same plane as, the pitman arms. Worn idler-arm joints ruin the fixed front-wheel toe-in setting.

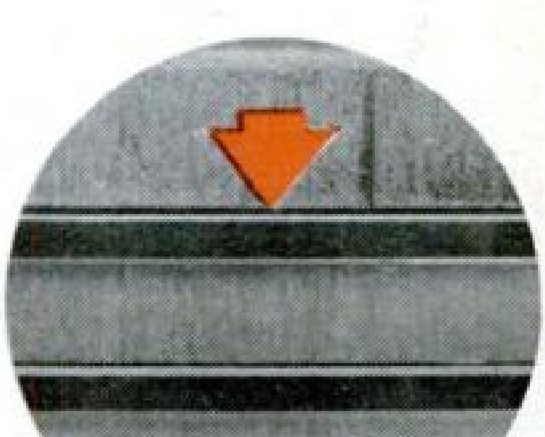
To check for wear, remove the idler-arm stud from the relay rod. Unbolt the idler-arm support from the frame. Hold the arm in a bench vise, tighten a nut on the stud threads, and measure the torque required to turn the stud. If less than one foot-pound or more than 10 foot-pounds is required, the stud is too loose or too tight and the entire idler arm should be replaced. ■ ■

Urheberrechtlich geschütztes Material

"It's doubtful that we could have won the Indy 500 without Perfect Circle ductile iron top rings."

Left: George Bignotti Right: A. J. Foyt

That's what A. J. Foyt's chief mechanic and world-famous racing engine expert, George Bignotti, thinks of PC durability. The piston at right dramatizes his point. It's an actual nurlized piston from A. J.'s winning 1964 car. The wear in the top compression ring groove is *three times* greater than normal – caused by fire extinguisher chemical residue on the track. Yet, despite this unusual punishment, new Perfect Circle ductile iron top rings on all four pistons continued to perform perfectly. No wonder Perfect Circle piston rings rate so high with top racing experts.



Top ring groove in piston from Foyt's Sheraton-Thompson Special wore to side clearance of .010". Normal clearance is .003" to .0035".

PERFECT CIRCLE

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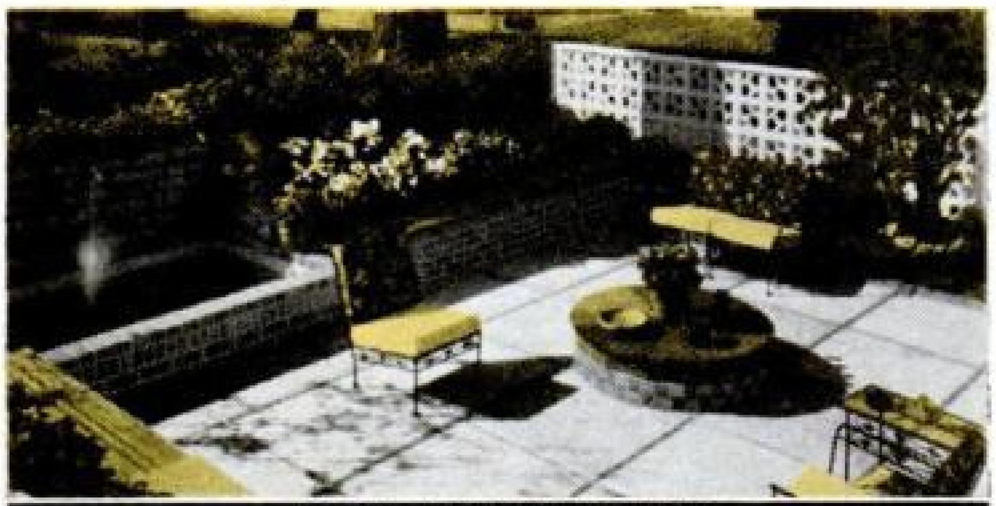
See how little it costs to add beauty like this to your home



Patio Floor – 10' x 12' SAKRETE Cost – $45.00

Pool – 4' x 6' (Inside) SAKRETE Cost – $42.15

Fire Pit – 32" dia. SAKRETE Cost – $9.90

Lawn Edging – 20' Long SAKRETE Cost – $4.95

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To assure your success—every time—SAKRETE Cement Mixes are laboratory controlled, and have up to twice the strength of concrete or mortar ordinarily required. You can build or repair a little at a time, start and stop anytime, for SAKRETE Cement Mixes store indefinitely until you add water. Use them to patch sidewalks, set or repair brick or stone work . . . for any concrete construction or repair. For best results, INSIST on the bag with the yellow diamond.

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concrete and mortar mixes

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[Continued from page 101]

urban air could be silent, the one-lung engine a hum. Mowers, tillers, chain saws could all be powered by electric motors. And yet there would be no trailing cord to trip over. To cut the lawn, you'd just light a small kerosene burner built onto the mower. Around its flame, a group of thermoelectric cells would convert the heat directly into electricity for the motor.

Inside the house. Midget fuel cells or thermoelectric converters (heated perhaps by radioactive capsules) may operate the vacuum, mixer, or quarter-inch drill.

Eventually you may roof your house with shingles of silicon solar cells, which convert light into electricity. Unfortunately they would generate only during the day, not during the night when you need them most. But there's a way around that. You use the excess daytime power to electrolyze water —dissociate it into hydrogen and oxygen gases. At night, you feed the hydrogen and oxygen to a fuel cell to run lights and TV.

Thermoelectric cells for homemade power are much nearer. They are already fairly efficient, and they too work on "free" energy —heat that is ordinarily wasted. The little generator in your gas water heater is a thermoelectric cell. From the heat of the pilot flame it makes enough electricity to keep the safety valve open. If the pilot goes out, the electricity stops and the valve shuts off the gas.

Within a few years, you can expect most home furnaces to be completely self-powered, with no connections to utility lines. This will mean a real saving in your electric bill, and also in installation charges.

The chimney pipe will be wrapped with thermoelectric cells to generate current from the heat that ordinarily is lost. The output will run the thermostat, oil-burner motor, and air blowers or water pumps— at no cost to you.

For large quantities of electricity, utility engineers are pushing research on MHD, which promises to cut the cost of power delivered to your home. MHD is a new kind of dynamo that eliminates the steam turbine. Steam plant efficiency is little better than 40 percent. MHD should hit 60.

Startling as these ideas may seem, none are dreams. They have all been built on an experimental scale, and they work. A few of them are in commercial production right now; the others will be soon. ■ ■

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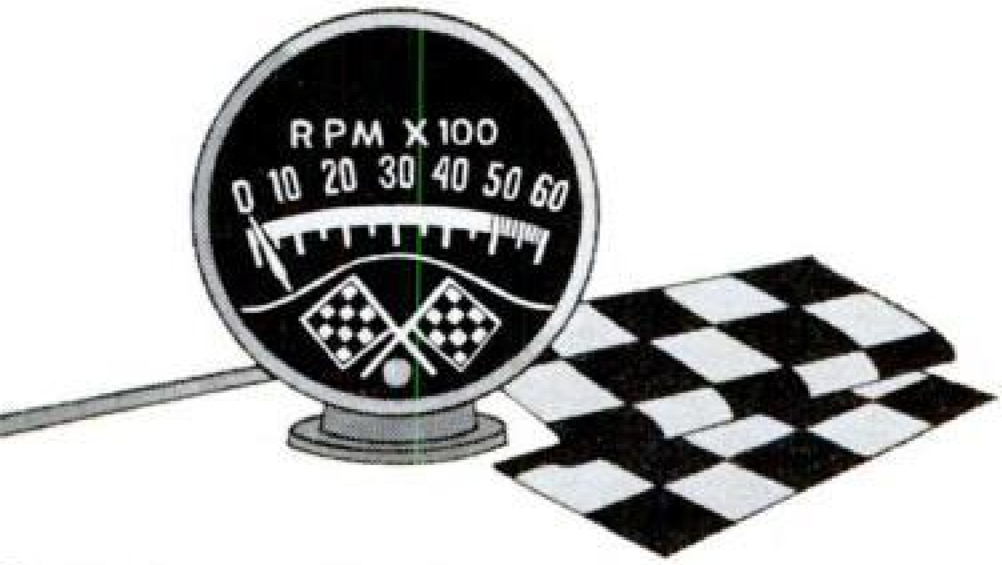
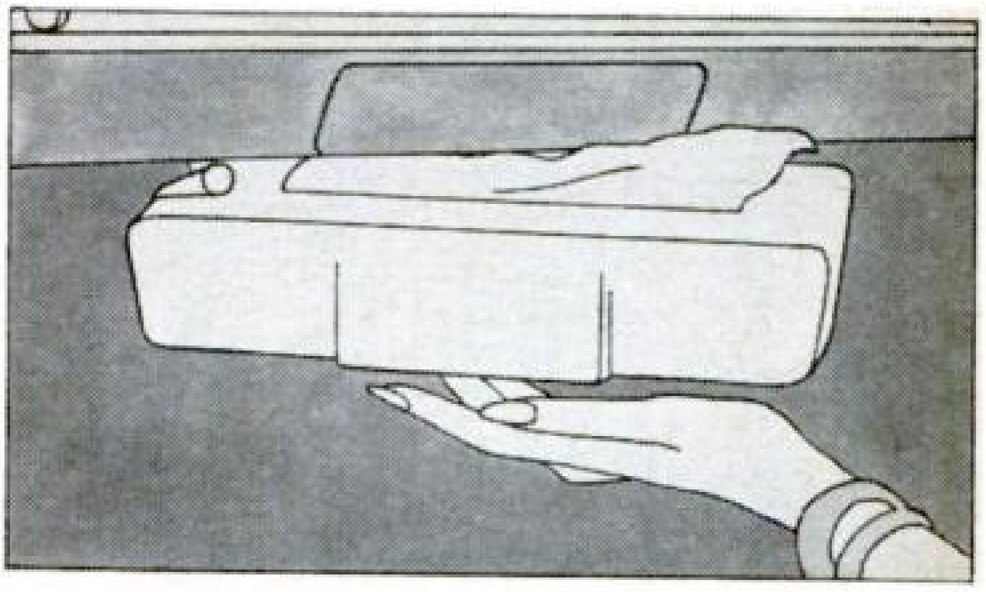
Who's got everything for your Ford

from Tachometers...

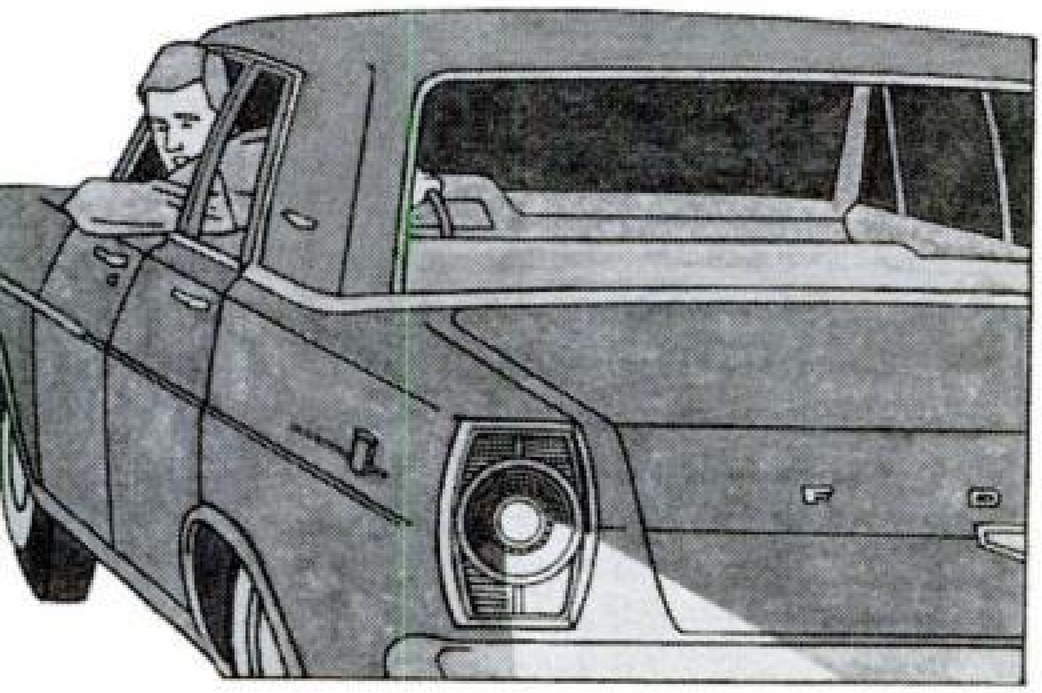


Choose from a wide variety of tachs for use in precision shifting and engine evaluation. Models available for instrument panel or steering column mounting . . . for 6- or 8-cylinder engines. From $31.75*



to Tissue Dispensers

Add an extra touch of comfort to your car with this tissue dispenser. Chrome plated for lasting beauty, it pivots from under dash for easy use. Holds regular size box of tissues. $3.95*



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Make nighttime backing safer, easier, with these powerful backup lights. They automatically switch on when you shift into reverse to flood the area behind your car with light. From $10.40*

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These self-regulating, night-illuminated clocks are a must when minutes count. They are available for either pedestal mounting atop dash or in instrument panel. $20.80*

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NEW from Du Pont

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DOES TWO JOBS . . . All transmission fluids contain certain additives which wear out with use. Du Pont "T-Seal" is formulated to replace those worn-out additives and to revitalize the transmission fluid.

IT'S A SEALER . . . Du Pont "T-Seal" stops automatic transmission leaks by chemically reconditioning the hardened, leaking seals. Prevents leaks from occurring by keeping seals soft and pliable. Saves costly transmission overhauls.

IT'S A TUNE-UP . . . Du Pont "T-Seal" renews the efficiency of the transmission fluid itself. Prevents formation of harmful sludge and varnish which could damage precision-built transmission parts. Helps stop slippage and assure quiet, smooth shifting. Prolongs the life of the transmission.

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EXCLUSIVE OFFER—Save up to $3.00 on a set of Classic 7 Cars "Matchbox" Series—Models of Yesteryear. See the Du Pont display and money-saving coupon where No. "7" products are sold.

How to Get Out of a Dead-End Job

[*Continued from page 105*]

Most men are more limited by their own fears than by real limitations. I talked with one man who had completed two years of college, but was now resigned to an unskilled job for the rest of his life. He couldn't go back to college, he felt, because he had to support his family, although he had access to a municipal university that provided night classes and could also take extension courses at the state university. Furthermore, his company paid for correspondence courses completed by its employees. Yet, there he sat, so paralyzed by his fears and his sense of inadequacy, that he could do nothing.

So often, the prospect of spending years in technical or professional training frightens people. What they don't realize is that they are going to live those years anyway. The difference is increased satisfaction, status, and money if they spend some time in training. They would be foolish not to make the effort. But because they can't visualize taking one step at a time, that goal seems unattainable.

It's one thing to fail because you don't have a certain skill or talent, or because of business reverses. It's another to fail by giving up. How can you tell the difference? Here is where you can make good use of your model and of a guidance counselor. Talk with someone, to get feedback on how you are doing. You'll find that you tend to underestimate your progress and to undervalue your capacities and ability.

• *Don't become one-sided.* Some men set a goal for themselves and pursue it as if they had no other interests or responsibilities. That means sacrificing the family to a single goal. Few goals are worth that. If you work out your plans with your wife and do so in such a way that you can devote some time to your family, some time to your recreation and pleasure, and some time to your self-development, then you'll move ahead in a well-rounded, solid fashion.

You also need to "think big" to get ahead. The famous English poet, Browning, wrote that a man's reach should exceed his grasp or "what's a heaven for?" A man should dream; he should not be afraid to challenge himself or to demand of himself. Dreams may sometimes be fantastic, but what is even more fantastic is that many people have been able to make their dreams come true. ■ ■

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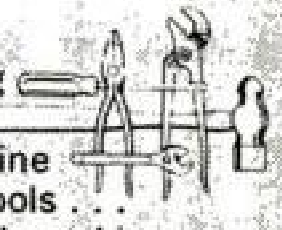

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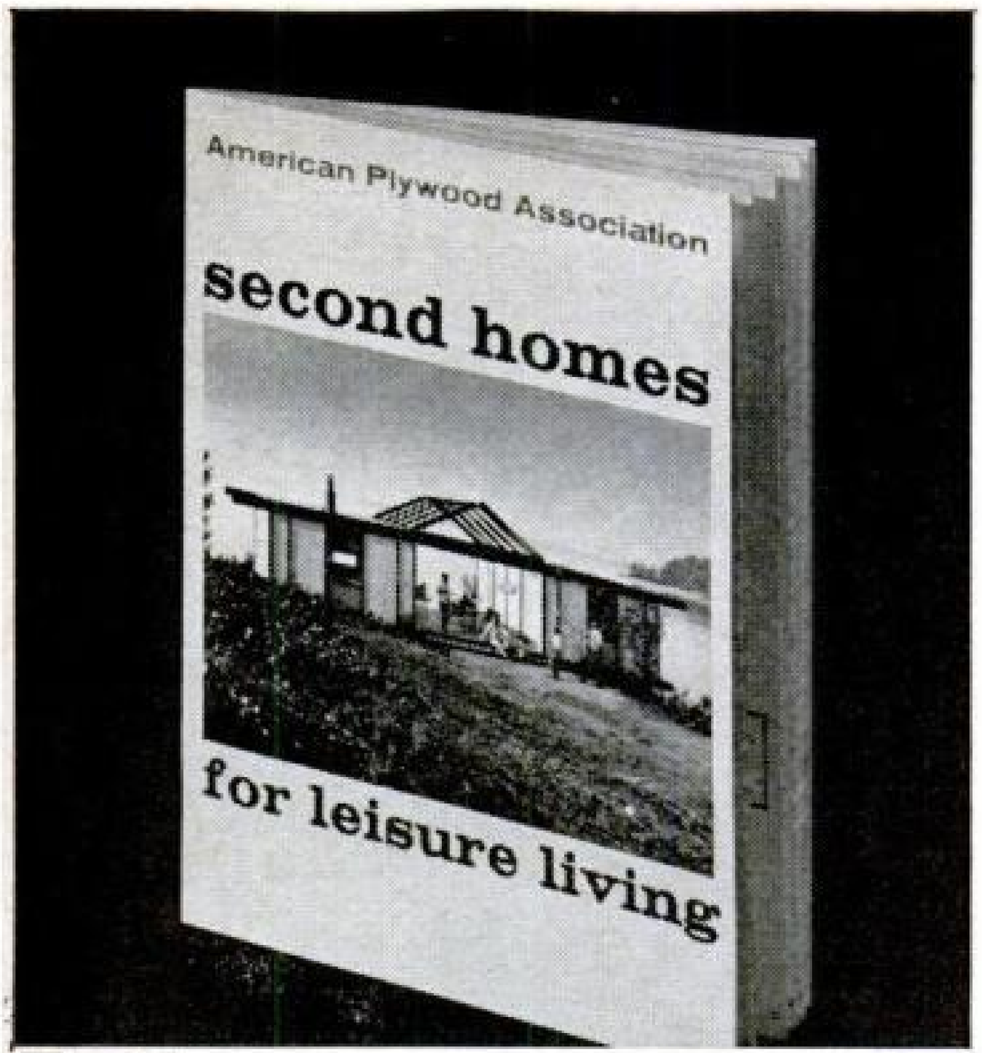

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Build This 3-Way Boat for Less than $50

[Continued from page 133]

If you omit the pontoons, make the alternate crossbar shown. This is designed to take two shorter leeboards, one on each side, for better balance when running without the pontoons. The same type of bar can also be used to mount a small fishing motor to one side of the stern. Mount two blocks near the stern similiar to those that hold the outrigger beam in place. Bolt a two-by-four across these so that one end protrudes 12″ to 18″ beyond the left gunwale. A small upright board can then be bolted to the face of the two-by-four to take the engine's clamping bolts. If you prefer, you can also buy a commercial side-saddle engine bracket made for use on canoes. The engine doesn't interfere with either rudder or running gear.

The length of the tiller bar depends on whether you like to steer from the rear seat or from down in the cockpit ahead of the seat.

The pontoons. These are made by sawing a 7″-by-20″-by-4½′ block of Styrofoam in two lengthwise. This produces two 7″-by-10″-by-4½′ blocks. Use a rasp to shape the noses to a point. It's not necessary to drill the blocks for the ⅜″ threaded rods. They can be driven through with gentle tapping.

The Styrofoam plastic, made by Dow Chemical Co. of Midland, Mich., is available from Dow dealers, plastics suppliers, and many boatyards and marinas where floating docks are used. A similar material made by Cellulite Corp. can be obtained from Gilman Brothers Co., Gilman, Conn. Use only water-base paint on the pontoons or leave them unpainted. Don't use an oil-base paint as it will disintegrate the plastic.

The sail is a lateen type. It is similar to those used on canoes and sailboards. Lay out the sheet so that the main threads in the fabric run in the same direction as the trailing edge of the sail (leech). This is important as it keeps the material from stretching under wind pressure. Use the scrap pieces cut off the sheet to fill in the corners at the top and front of the sail.

Note that pockets are sewn into the sail for the spars. These eliminate the need for inserting grommets in the material for rope and make for a stronger fastening. If you prefer a somewhat fancier sail, use canvas, dacron, or a similar water-resistant material instead of the bed sheet. Or you can buy a ready-made canoe or sailboard sail. ■ ■

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Pulls an elephant...runs on peanuts

e new 90 hp Merc 900 can pull an elephant
it uses less fuel than 75 hp outboards. The
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meter for less slippage and cavitation drag. Mercury's new dry exhaust system reduces back-pressure, improves engine breathing, and boosts power at the prop.

50% Quieter. This new exhaust system also helps make the new Mercs 50% quieter. Silencing was accomplished by using new principles of sound engineering . . . not by adding fat, sound-and-gasoline absorbent padding.

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THE PIPE TOBACCO THAT STAYS LIT

Bond Street keeps burning because of its old English cut—a combination of flakes for even burning, and cubes for slower burning. You'll like its aroma of fine domestic and imported tobaccos, too.

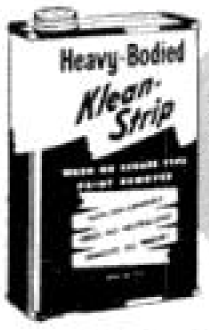
A word to novice pipe smokers

Don't overwork your new pipe. Fill it half full for the first few smokes. Then let your pipe cool off. If you try to take it apart when it's hot—it can easily break.

A philosopher without a pipe is like a gossip without a tongue.

A product of Philip Morris Inc.

PEEL OFF PAINT with KLEAN-STRIP



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THE KLEAN-STRIP CO., INC.
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Hot-Rod Houseboat

[Continued from page 110]

The Chryslers' power was transmitted to twin Dana stern-drive units. Thus, the River Queen can be headed into shallow water or beached the same as any boat equipped with retractable stern-drive units. Also, since the outdrive units steer like an outboard, the big houseboat has the maneuverability and stern-steering control of an outboard. Yet because these outdrives are mounted so far apart, they also give the helmsman much of the twin-screw control of an inboard.

Steady as she goes. I tried nosing into a slip, to see how this unusual combination of inboard and outboard control would work. Due to an unexpectedly strong current in the Saugatuck River and my own inexperience with this combination of controls, I didn't make it the first time nor even the second. But it didn't take too long to get the hang of it and put the 12-foot-beam hull square between the goal posts. With this combo, you have the feeling that you've got the best of two worlds at your fingertips.

What do you call a boat that has a house on it, and can win big-league rough-water races? One thing is certain! You definitely don't call it a houseboat, claims R. E. Peterson, the supercharged Swede who took up a welding torch and created the first River Queen more than 15 years ago.

It's a new breed of boat, he says, and he's ready to match it against anything that touches water. He spent several happy days doing exactly this at the Marine Trade Exhibit and Conference at Chicago's McCormick Place, right at the channel of Burnham Harbor. Throughout the Conference, dealers got full-throttle demonstration rides out into Lake Michigan. Pete repeatedly nosed his River Queen against the pilings, took passengers aboard via the handy bow steps, and promptly raced anything leaving the harbor at that time.

It was a rare boat that could beat him, let alone get out on the lake first. He even challenged a big hydrofoil and it never did pull away from the Queen until it had gotten up on plane on its underwater wings.

Nobody landed a seaplane at McCormick Place during the show. It's a good thing, for Pete and his River Queen would undoubtedly have participated in the take-off run! ■■

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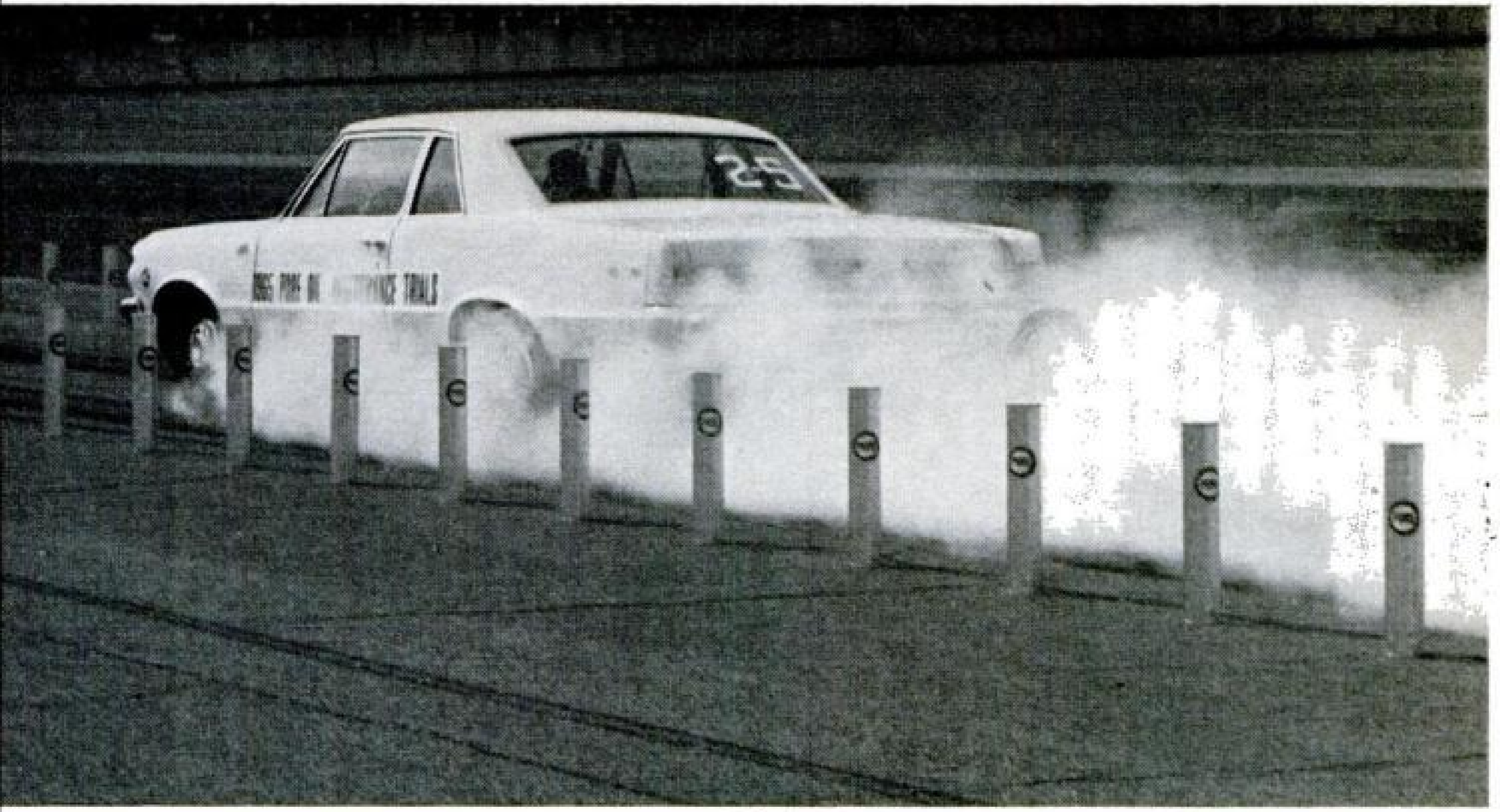


This is The Pure Oil Performance Trials braking test, one of three exacting tests in The Trials—that test *cars,* not drivers.

Who just won The Pure Oil Performance Trials, the meanest new-car tests of them all?

Take a look.

Oldsmobile 98 Holiday
won Class I (Luxury)

Pontiac Bonneville
won Class II (Deluxe 8 cylinder)

Chevrolet Impala
won Class III (Medium 8 cylinder)

Buick Special Deluxe
won Class IV (Small 8 cylinder)

Oldsmobile F-85
won Class V (Standard 6 cylinder)

Ford Falcon
won Class VI (Compact 6 cylinder)

Ford Mustang 2 + 2
won Class VII (Sport compact)

Tests for acceleration. Tests for economy. Tests for braking. The 1965 Pure Oil Performance Trials were mean because they were thorough.

They didn't just test gasoline mileage that saves you money.

The Trials also tested brakes and acceleration—things that can save your life.

And there were no loopholes. None for the cars; none for the drivers. The National Association for Stock Car Research saw to that. (NASCAR sanctions and supervises The Pure Oil Performance Trials.) Every entry was taken apart and inspected by NASCAR, to make sure it conformed to the Automobile Manufacturers Association specifications. The running of The Trials was done in accordance with a rigid set of rules designed to eliminate driver skill as a factor in the results.

So if you want to know how the '65 cars really perform, check the winners at left.

Then stop at any of the Class Winners' showrooms.

They'll be glad to tell you who they beat.

The 1965 Pure Oil Performance Trials!

Urheberrechtlich geschütztes Material

[Continued from page 153]

the joint is fully filled with the shiny molten braze metal. Then remove the flame and allow the joint to solidify. Using pliers or tweezers, drop the still-hot work into cold water. Finish up by cleaning off the hard flux residue and polishing the joint to a bright shine.

Too much heat can be as harmful as too little. If a joint is heated too long, the metal will blister, stain, burn, even melt. The protective coating of the flux also breaks down under too high a heat. Once the parts have been brought to red heat, the rest of the brazing process should be completed as quickly as possible.

Sometimes the parts will reach white heat and even melt and still the braze metal will not flow. In this case, the problem is not heat but dirt or chemical contamination. Solution: Cool the parts, clean them vigorously, and start over again.

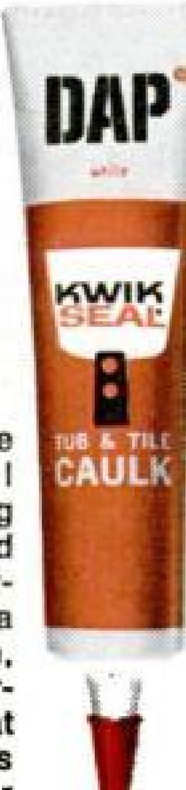
In fine silver brazing, oil vapor from your skin can sometimes keep a braze from taking even though you don't actually touch the joint. One answer is to wash the parts first in a warm, weak solution of sulfuric or hydrochloric acid—a pickling bath. This helps clean the metal chemically. The metal must then be rinsed in plain water before fluxing.

The type of mechanical joint you make also affects the strength of a braze. The greater the contact area of the parts, the stronger the bond between them. This is why the best joints are those in which the parts are overlapped or interlocked in some way instead of simply butted together.

Where to buy supplies. Brazing rods and fluxes are stocked by welding-supply houses and by some hobby shops. These can be located through the classified section of your telephone directory. The materials can also be obtained from mail-order houses like Sears, Roebuck and Montgomery Ward.

In addition, some well-known makers of brazing supplies are: Aluminum Co. of America, Pittsburgh, Pa.; William Dixon, 3236 E. Kinney St., Newark, N.J.; Eutectic Welding Alloys Co., 40-40 172 St., Flushing, N.Y.; Handy and Harmon, 850 3rd Ave., NYC; Hoover and Strong, 119 W. Tupper St., Buffalo, N.Y.; Victor Welding Equipment, 844 Folsom St., San Francisco, Calif. ■■

CAULK TUBS!



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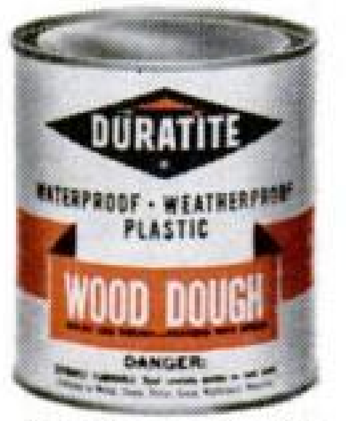

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smoothly into cracks, break
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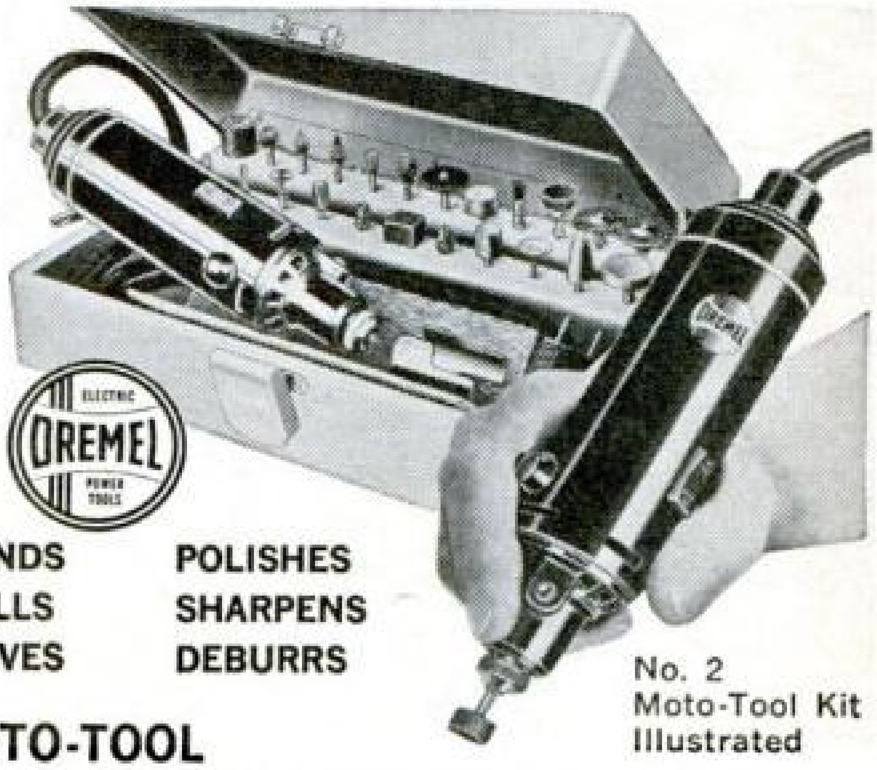

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NEW HEAVY DUTY NO. 3 MOTO-TOOL

New high torque motor designed for hard industrial use. Same features as No. 2 plus 50% increase in power.
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Urheberrechtlich geschütztes Material

[Continued from page 149]

drill. The usual form consists of a center pilot drill surrounded by a saw-toothed ring that cuts out a circle of desired size. Rings of different sizes can be interchanged so that one saw can usually cut holes from a little over 1" up to 3" or so. One neat version is Skil's Dial Saw, which can make any size hole from 1⅛" to 2 7/16".

Multi-spur bits are not hole saws, but look and work something like them. They have a toothed rim—actually, a series of spurs—combined with a central cutter that scoops out the wood cut away by the spurs. They bore cleanly and easily, their only drawback being that you need a separate bit for each size hole you want to make. Greenlee makes them in ½" to 4" sizes.

In the same general class is the fly cutter—a center pilot drill with a single cutter flying around it on the end of an arm. By adjusting the length of the arm, you vary the radius of the circle cut. Fly cutters are not easy to control in a hand-held drill, but do fine in a drill press. Their advantages: low cost and infinite adjustability over a range of several inches.

Screw bits. Screw holes are relatively small, but for a good job you need one size for the thread, another for the shank, and a countersink or counterbore for the head of the screw. Combination screw bits make all at one time.

Instead of beveling the edge of the hole like an ordinary countersink, Stanley's Screw-Sink scores a circle around the hole. The screw head compresses the wood around this circular groove, making a tight grip and a perfect seal as it's sunk. Driven further, the same tool bores a hole that fits plugs made with Stanley plug cutters.

Stanley's Screw-Mate countersinks, on the other hand, have a fixed stop collar for accurate and uniform countersinking, but they can't counterbore. Sears, Roebuck sells a similar set with adjustable stop collars to permit counterboring. Adjustable for different screw lengths of like body size, Millers Falls Screw Guides can be set to countersink or counterbore.

Auger bits. For hand boring with a brace, the auger bit still holds its own. It's made in sizes from ¼" to 1½", numbered in sixteenths. Thus a No. 14 bit is 14/16" or ⅞".

The twist—part of the shaft that carries out chips—comes in three styles. The familiar double twist pulls chips out rapidly on both sides. The solid-center twist has a single spiral around a sturdy center shaft, making for a rigid tool capable of heavy boring. Ship-auger twists resemble a spiral of steel ribbon, with a hollow channel inside. In deep boring, chips flow out this channel like oil through a pipe.

Screw tips pull the bit into the work, taking some of this chore off your muscles. They may have single or double threads. The coarser single bites more deeply into wood, and pulls harder, but is more likely to splinter the wood as it breaks through. Double threads are gentler in action. Pitch or distance between threads determines how far the bit advances at each turn; a fine-pitch point is best for most work.

Spurs outline the hole, severing the wood fibers ahead of the cutters, which then come along and lift them out like a pair of guided chisels. The cutters also start the chips up into the twist.

Variations of the auger bit may have one spur or none at all, a single cutter instead of two, or cutters that slope to form a V angle. Sometimes a side lip is provided to outline the hole.

You can't use auger bits in a power drill. The screw point will feed so rapidly it will either stall the drill or yank it out of your hands. Two modifications will make an auger bit work under power, but render it unsuitable for use in a brace. The first is to cut off the square shank. If the straight part below is too big for a ¼" chuck, a 5/16" adapter may make it fit.

The second modification is to file three or four flats on the screw point, removing most of the threads. The bit will no longer be self-feeding, but it will be far more manageable under power.

Expansive bits. These bore odd-sized holes between standard sizes, and big holes beyond the range of auger bits. They have a spur and cutter on a movable arm, infinitely adjustable within a certain range (⅝" to 1¾", ⅞" to 3", for example). This cutter arm is wedged tight by a clamping plate. In some bits, a vernier adjustment is provided by a worm working in teeth.

The shaft has no twist, but a screw point helps pull the bit in, and an extra lip on the body bores out the center part of the hole ahead of the big cutter. Expansive bits are for use in a hand brace and not recommended for power drills. ■■

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For 20 years, the paint on this house blistered so badly it needed repainting nearly every year. Then, 3½ years ago, it was painted with Dutch Boy Latex House Paint. We're still waiting for the first blister.

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Some house paints seal in moisture. Not Dutch Boy Latex. It lets the wood "breathe," to prevent cracking, blistering, and peeling. Dutch Boy Latex goes on easily. Without thinning or mixing. Without days of drying. Without any worries about matching colors, even years later. It covers wood, metal, masonry—just about anything a house could be made of. And once it's on, it stays on. Colors resist fading. White resists yellowing. (Dutch Boy's exclusive acrylic resin sees to that.) Even after years of steam and moisture on the inside. Even after years of rain and New England snowstorms on the outside. That's why we call Dutch Boy the paint with more years to the gallon. And why you should call your Dutch Boy dealer. He's listed in the Yellow Pages.

Dutch Boy Paints. More years to the gallon.

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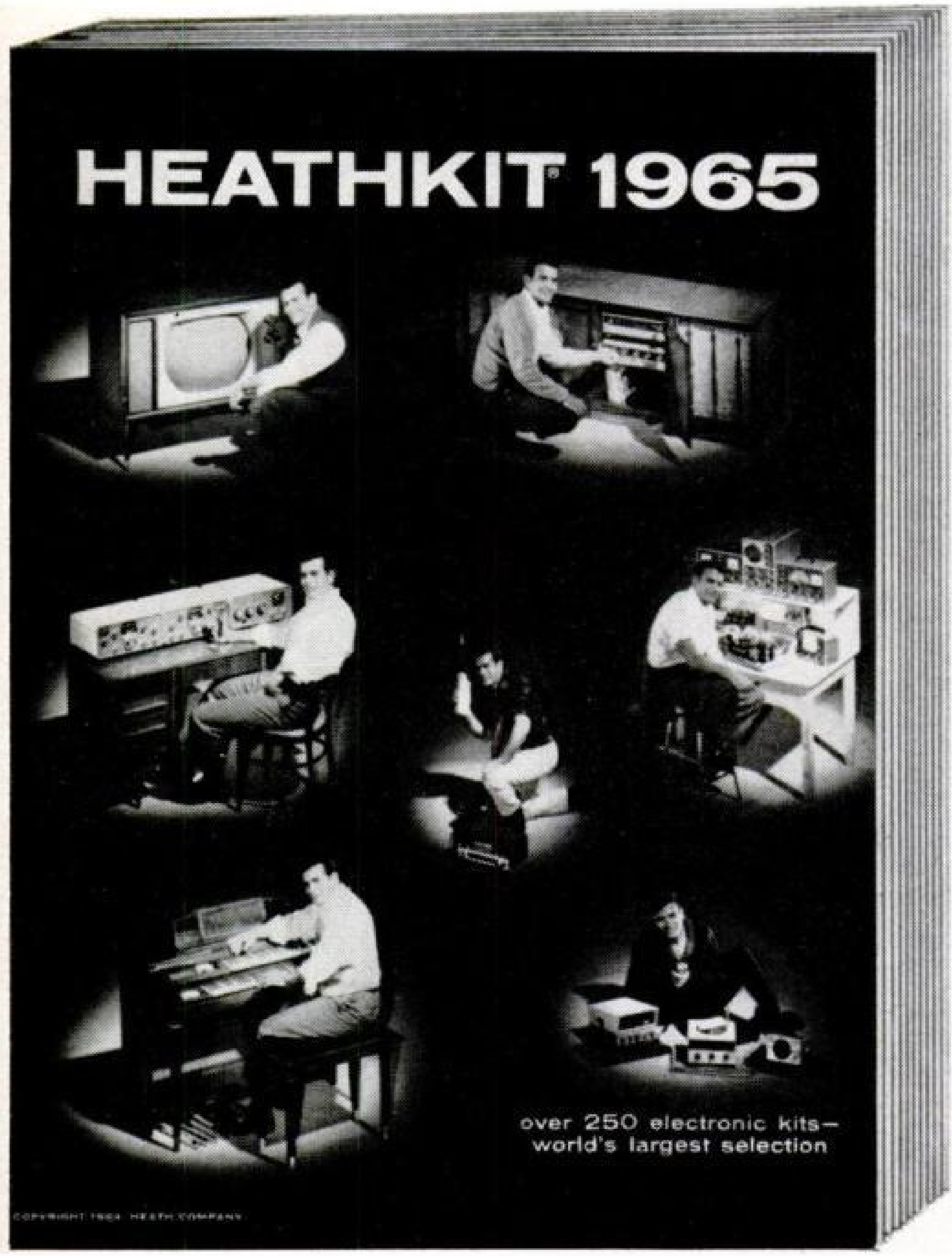

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New Olds Front-Wheel Drive!

[Continued from page 66]

of where the wheels are pointing. This does not happen with front-wheel drive, where front-end breakaway is a stable motion with a self-diminishing tendency. The car may be basically understeering, but it understeers less at high speeds than at low speeds, while with rear drive the situation is just the opposite. The prophets of front-wheel drive are right when they speak of extra safety in extreme conditions.

Other benefits of a front-drive system show up when driving on rough roads. It gives the car better traction and stability. The increased stability shows up on rutted roads, uneven roads, and at high speeds in a strong crosswind. The front-drive keeps going in a straight line instead of lurching from side to side.

Back to 1904. America has rich traditions in front-drive cars, starting with the 1904 Christie, leading through the Millers and Gregorys of the Twenties to the Cords of the Thirties. Checker had a front-drive taxicab in service from 1946 to 1951; Chrysler built an experimental front-drive model in 1956; Chevrolet showed the Universelle front-drive panel truck in 1958; and Ford has had front-drive Thunderbirds on test since 1957.

The natural question at this point is: Why is Olds bringing out this car if it is so similar in operation to a conventional car but costs so much more?

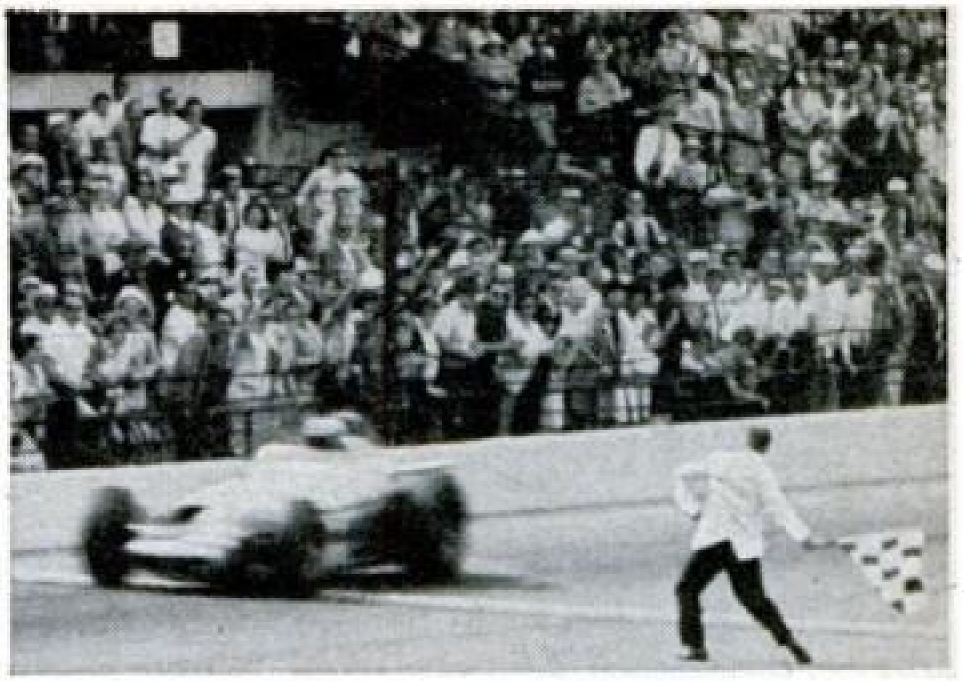
We went to the marketing boys with this one and they had a ready answer.

"People want something different," they explained, "and they will spend extra money to have it."

Look at today's market, say the experts. Bucket seats, consoles, floor shifts, four-speed manual transmissions—they all cost more, and people buy them because they are different.

Olds' experiment is being closely watched by GM's competitors—especially Ford—to see what the market reaction is. Ford has already made provisions to build a front-drive Thunderbird in 1967 if the Holiday catches on. The Holiday may also give extra impetus to the Chrysler Corporation's turbine project.

Oldsmobile is getting some reaction from its sister divisions in GM as well. Word around Detroit is that every other GM division except Pontiac is considering a front-drive car of its own. ■ ■



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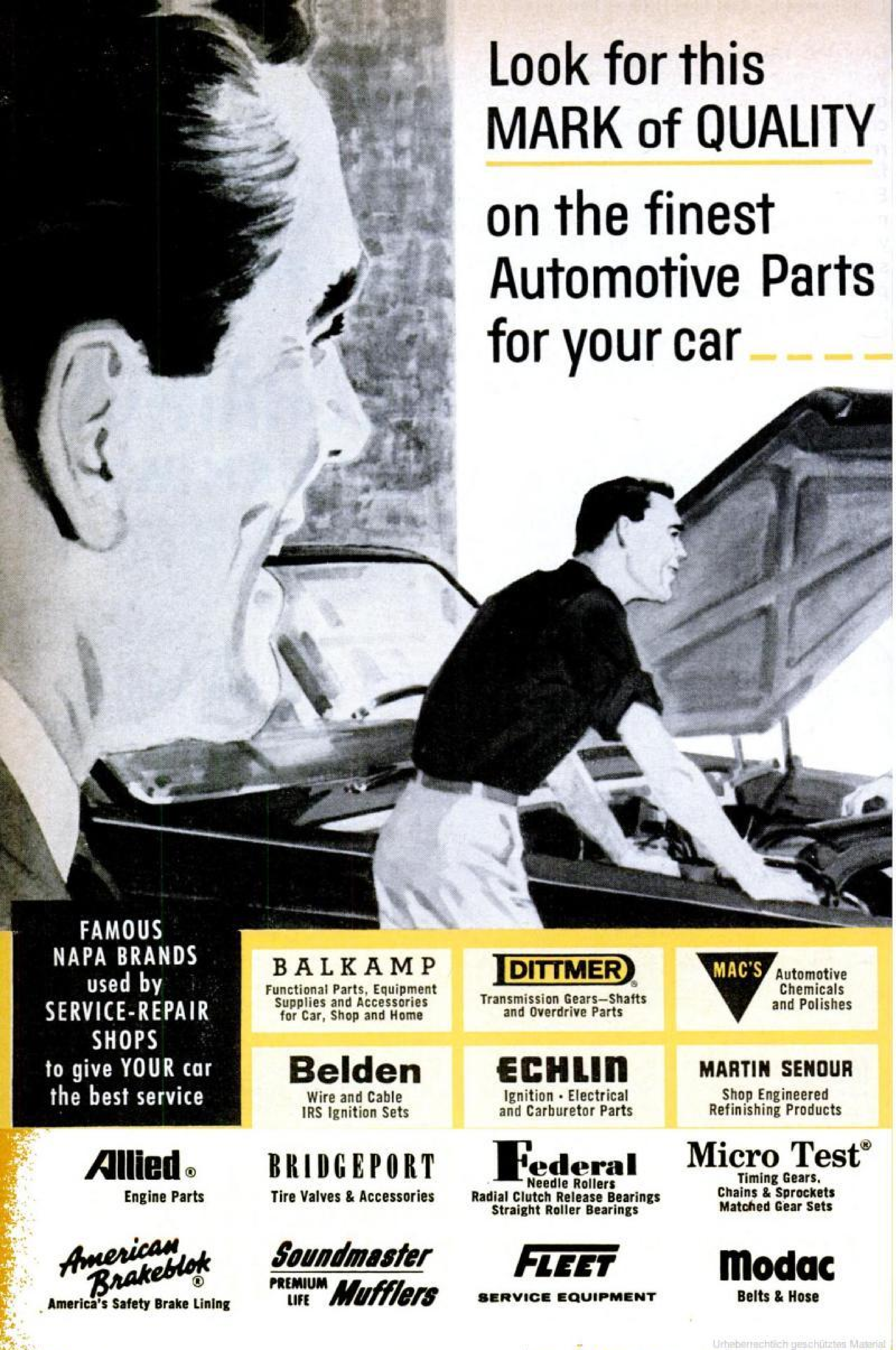

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What an Astronaut Will Wear on the Moon

[*Continued from page 88*]

Pictures of Mercury astronauts emerging sweat-drenched from their capsules have conveyed, in a rather telling way, the need of active cooling for a man hermetically sealed in a pressure suit. Oxygen circulated through the Mercury suit, before launch and during flight, was called upon to remove body heat. But water-circulating plastic tubes, embedded in a net-weave under-garment, have been found far more effective—and are therefore used in the Apollo suit.

The heat absorbed by the cooling tubes is dissipated in the astronaut's backpack by a porous-plate "sublimator"—a novel sort of radiator for space conditions. Warmed water from the cooling tubes is sucked into pores of a plate whose other side is exposed to the ambient vacuum. The water freezes in the pores, due to pressure drop and evaporation.

As the resulting ice sublimes (evaporates without melting) into the vacuum outside, the "ice plug" in each pore grows thinner. Ultimately it blows out, the pore refills with water, and the cycle is repeated. Thus the porous plate serves as a stationary heat-rejection device.

A thin layer of nylon, whose texture and function can best be compared with those of a shirt, surrounds the water-cooled undergarment. This nylon layer also supports oxygen ducts, and wiring for medical instrumentation taped to the astronaut's body.

Next comes the sturdy "pressurization layer," a heavy bladder of neoprene-coated nylon. Its main function is to seal within the suit the astronaut's pure-oxygen atmosphere, which is at an absolute pressure of five pounds per square inch—about one-third of the atmospheric pressure on earth.

As could be expected, the design of easily movable joints at hips, knees, shoulders, and elbows posed a most formidable problem. For any flexible L-shaped joint, unless especially configured, has a natural tendency to straighten out under internal pressure. Of course this would mean that an astronaut thus encased would have to use brute force (and plenty of it) to bend a knee or an elbow.

Making joints easy to bend. The answer to this dilemma is the "convoluted joint"—a rubberized bellows joint, so designed that its total internal volume does not change as it is deflected. A complex system of internal nylon and wire prevents the bellows from

CONTINUED

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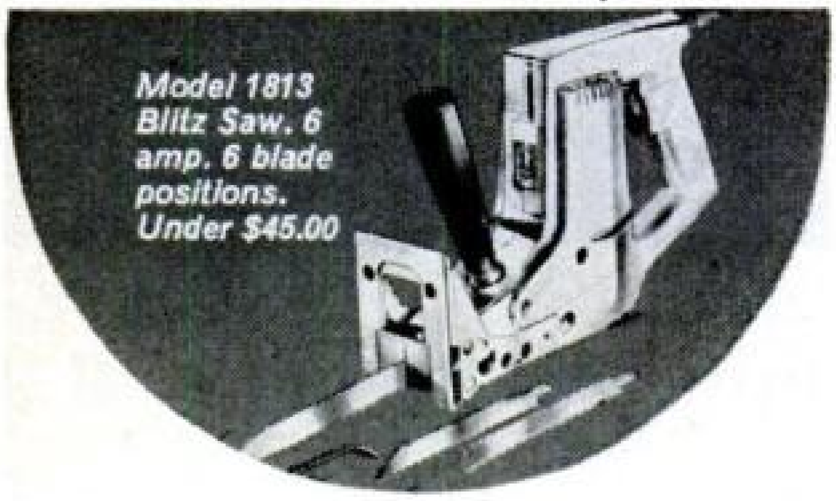

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expanding like an overpressurized accordion.

Other vital elements tied to the pressurization layer are the pressure-glove and boot connectors, and the helmet ring. Pressure gloves and boots are attached to the suit with quick-connect O rings and bearing seals to prevent oxygen leakage. The fiberglass helmet of the Apollo suit can be rotated on the astronaut's shoulders, if he so chooses, as he turns his head.

An outer restraint layer of nylon, aluminized on the outside, encloses the pressurization layer. It is this aluminized nylon layer that you see in the photograph of the Apollo suit on the opening page.

A "thermal overcoat," too. On the lunar surface, the Apollo astronaut will don in addition a loosely fitting overgarment—a two-piece set of pants and cloak of aluminized mylar and nylon. This will provide him with additional protection from the extremes of temperature between sunlit and shaded areas on the moon. It will also serve as a protective shield against grain-of-salt-sized micrometeorites, which are believed enough of a hazard on the lunar surface to warrant this extra protection. This thermal overcoat is contoured to fit over the life-support and communications backpack.

That is a preview of the way the Apollo astronauts will be dressed for the great adventure of setting foot upon the first of the celestial bodies to be explored by earthmen. ■■

About the "Crunchy Noise" of Lunar Footsteps

In an earlier article, Dr. von Braun ventured the opinion that an astronaut walking on the lunar surface, which may resemble hard snow in texture, "may hear a crunchy noise." But didn't he know, a number of PS readers took pen in hand to ask, that the moon has no atmosphere to carry sounds?

Of course he did; and his explanation is simply this: Suppose you were sitting in a car with tightly closed windows, and someone crushed a hard snowball against the outside of the car. The crunching sound would be transmitted right through the metal of the car's body, to the air inside the car, and so to your ears.

Likewise, the sound of an astronaut's lunar footsteps could be expected to be transmitted through his footgear to the oxygen atmosphere inside his suit—and so he would hear it.

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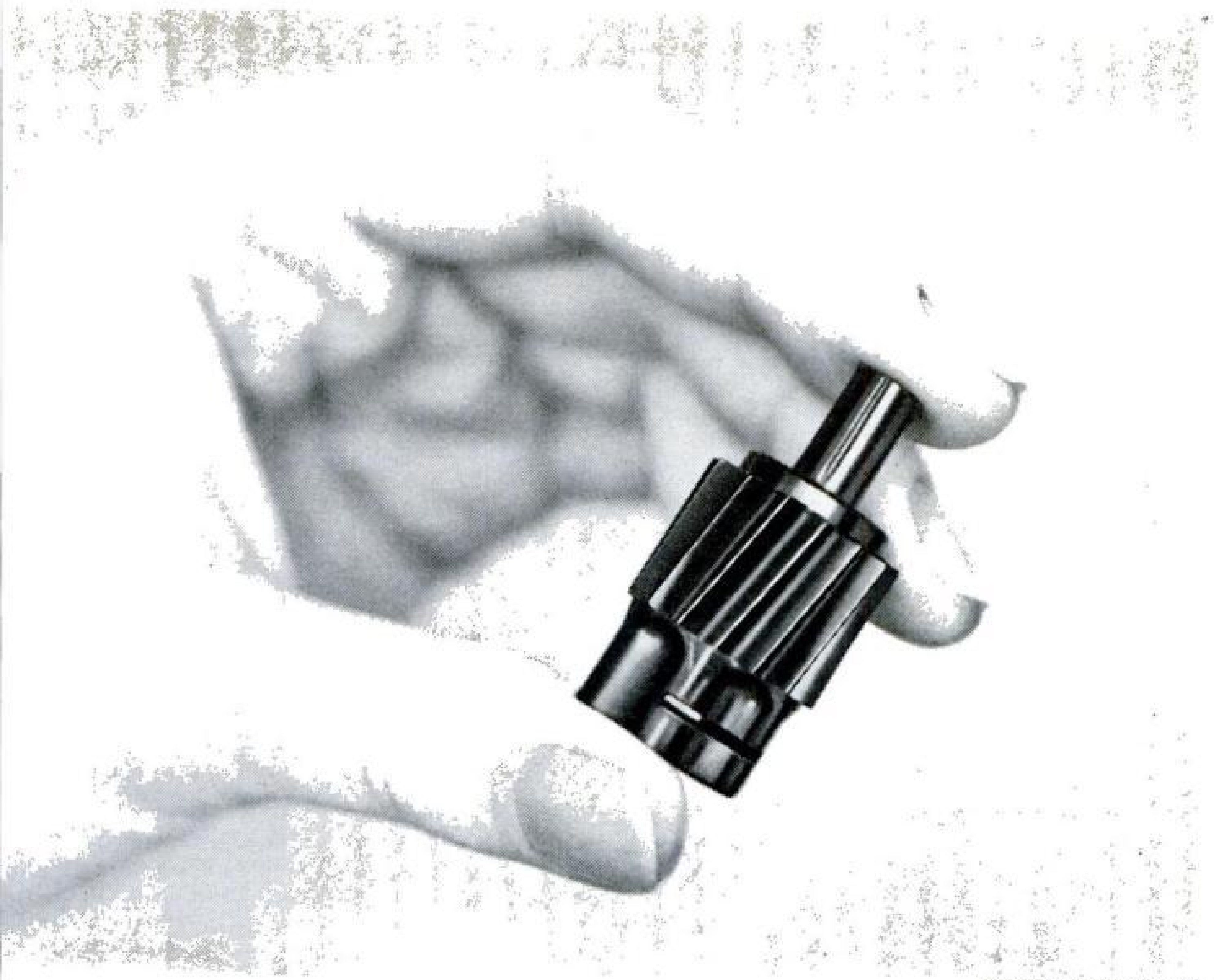

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New Radar May End Mid-Air Collisions

[Continued from page 77]

Electronic designers soon realized that the spurt of return energy could be made to do other things. By coding it (regulating the spacing between a group of rapid-fire pulses), the signal from one aircraft could be made different from all others. The man on the ground could thus tell which plane was replying.

By connecting the transponder to an altimeter, it is possible to transmit the plane's altitude automatically. Up to 64 such codes were possible in early versions of the transponder. More sophisticated models can generate up to 4,096 different pulse combinations.

There is a transponder of one sort or another on every U.S. military aircraft (about 20,000 in all). Of the 1,500 planes in the commercial carrier fleets, 1,100 have 64-code transponders. All of Boeing's new three-jet 727s are being delivered with 4,096-code transponders aboard.

Ground equipment to work with the 64-code transponders is today installed in all 21 of the FAA traffic-control areas that blanket the nation, and 4,096-code equipment will be standard—in commercial and military aircraft and on the ground—by 1968.

Another aspect of the plan is Area Positive Control. That means that all planes in a given airspace—within a defined area and above a certain altitude—are being tracked by ground controllers to maintain positive radar separation. In practice, only transponder-equipped aircraft are allowed to fly in the positively controlled airspace.

Today, Area Positive Control blankets nearly 100 percent of the U.S. above 24,000 feet, where the big jets fly (sparsely traveled bits, such as one strip along the Canadian border, are not covered). This year the floor is being lowered to 18,000 feet. And the FAA hopes to extend Area Positive Control right down to the ground around busy terminals—New York, Washington, Chicago, Los Angeles. Special corridors to smaller airports nearby will be provided for aircraft without transponders.

How does the system work? With the prevalent 64-code transponder, the pilot dials a two-digit code on a little control box in his cockpit (10 means climbing, 14 means descending, and other numbers indicate level flight within specific altitude ranges). The ground controller's console in-

cludes a set of switches that let him select one or more codes to be displayed on his radar scope. Aircraft with transponders set to those codes show up on the scope as double slash marks, other transponder-equipped planes are single slash marks, and planes without transponders appear as less-distinctive blips.

The controller can thus focus his attention on the airways and altitudes he is handling, and can easily watch the behavior of the planes within his responsibility. (He is informed by means of flight-progress slips and radio contact as to the identity of those aircraft.) In case of confusion, he can ask a pilot to push his "Ident" button. This makes the double slash mark for that aircraft fill in to a single thick marker and stay that way for about a minute.

When all aircraft carry 4,096-code transponders, each plane will be given an identity code as it takes off. Then, as it passes over the area handled by a control center, its identity, altitude, and other pertinent information will be printed out right on the face of the viewing tube. (Today, controllers push little plastic "shrimp boats" across the face of the tube, to keep track of flights under control.) Moreover, the 4,096-code data can be fed into a computer that will continuously monitor all targets in an area and sound an alarm if two planes appear headed for a collision. Then, by radio, a controller can order one of them to change course or altitude.

More automation coming. Computers are already being used in some of the FAA's 21 control centers, to automatically type out the "flight-progress strips" that tell controllers what aircraft are entering the airways they are watching. These strips must still be shuffled manually until a controller hands off the flight to the next control center, but the day of full automation is in sight. The FAA centers are being rapidly modernized with all sorts of helpful electronic gear, and Project Beacon (as the transponder system is called) is scheduled for full-scale operation around 1968.

By then, FAA experts confidently believe that mid-air collisions like the tragedy over Staten Island will be ancient history, never to be repeated, even though our nation's skies will become ever more crowded with aircraft packed with their precious cargo of human lives. ■ ■

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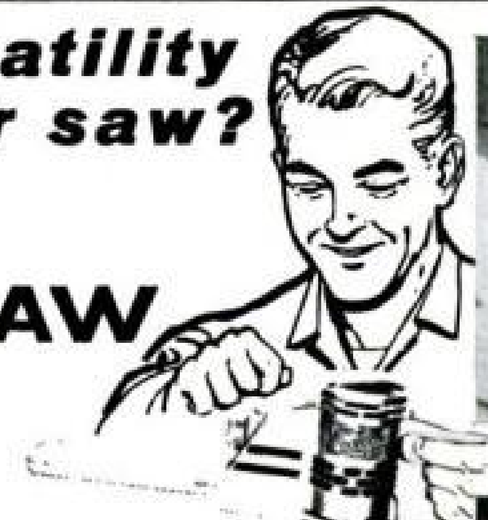

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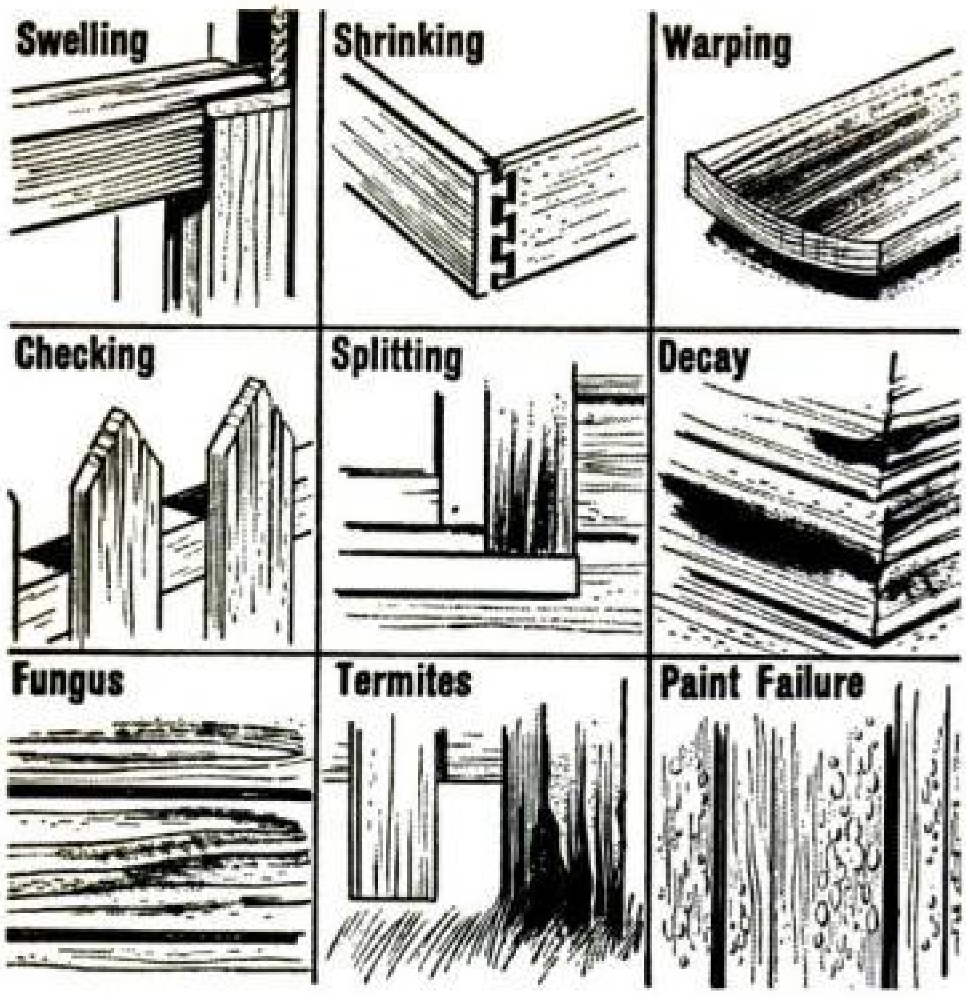

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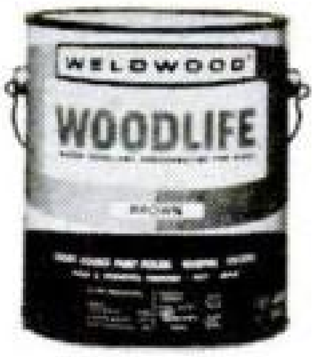

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How Fast Can You Stop?

[Continued from page 86]

been treated chemically to turn brown if subjected to a temperature of more than 347 degrees F.

After mechanics finished burnishing the brakes of a car, one front and one rear wheel were pulled. If the paint had browned for a continuous distance of three inches on the undersurface of the shoe table from the web to the outside edge, NASCAR declared it unsatisfactory. If a brake showed evidence of overheat, the opposite one was pulled. If that one, too, had overheated, penalties were imposed.

The reason for all this: Brakes that have been overheated and then cooled give shorter stopping distances—as every expert in the business knows. Overburnished brakes also wear out a lot faster.

Each car was required to use exactly the same kind of tires, with identical treads.

The problem—linings. The '65 Pure Oil braking tests perhaps pinpointed not so much brake design or construction as the necessity for more research on linings, in the opinion of one brake-lining-company representative.

In an independent test of 26 different brands of linings by NASCAR for the Grey-Rock Division of Raybestos-Manhattan, Inc., last September, one car required an almost unbelievable 1,568 feet to stop from a speed of 80 miles an hour. The shortest distance recorded was 516.4 feet. The average was 950 feet. All the linings were made of organic material.

The world's best auto brake lining is made of sintered iron, but it requires tremendous foot pressure before the lining warms up. Organic linings, almost universally used, are compounded of asbestos, resins, and various friction "modifiers" to provide the characteristics the manufacturer wants at a price he wants to pay. The modifiers include such things as iron oxides, rubber, graphite, even cashew-nut shells.

As a tribute to the care with which the trials are run—and to the cars' braking systems—14 identical sets of two cars each registered stopping distances within 10 feet of each other. Nine sets of cars were less than five feet apart. Only one foot separated the Olds Jetstar 88s, 7/10 of a foot the Chevy Novas, 6/10 the Pontiac Grand Prix, and 1/10 the Pontiac Bonnevilles.

For the customer wanting safety, that is as it should be. ■ ■

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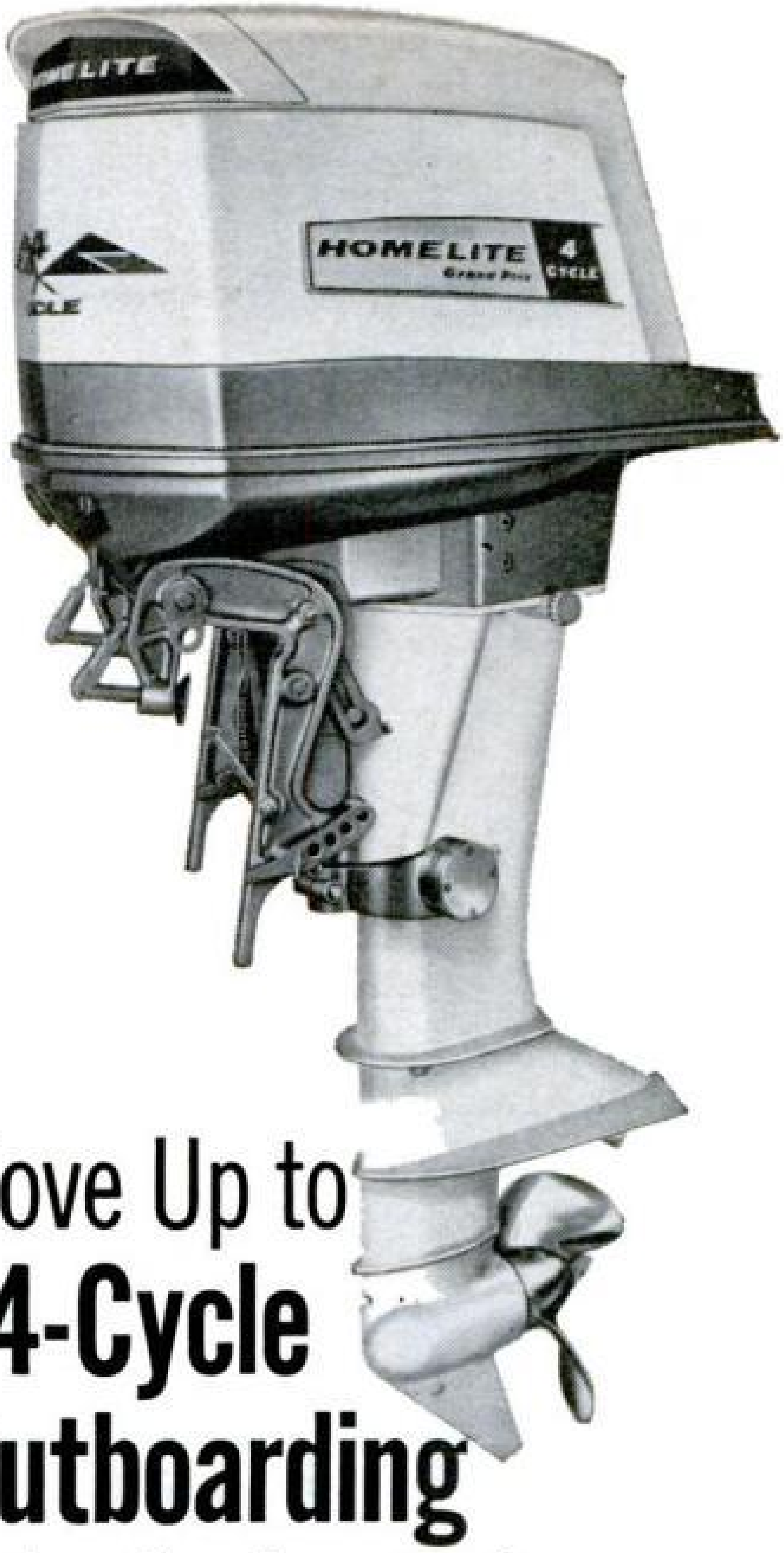

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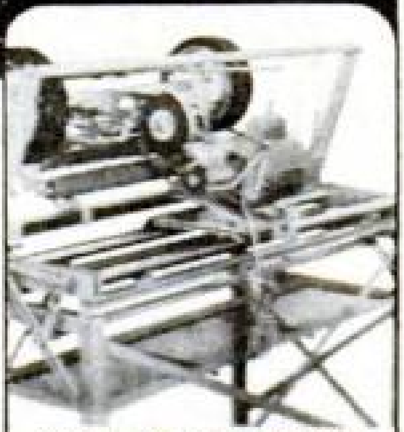

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Shopping for a Riding Mower

[Continued from page 173]

solid tires. A short turning radius is another tipoff to good maneuverability.

Width of cut. This varies from a minimum of about 24" to a maximum of about 34". Your choice depends mostly on how much you're willing to pay. Obviously, the wider the cut, the fewer the passes you have to make to cover the same ground.

But cost goes up sharply as cutting width increases. Even a few inches can make a difference of $100 or more in the price of a machine. There's also something to be said for the greater maneuverability that a narrow blade gives you around obstructions.

What is more important is the closeness of cut at the front and sides. This tells you how close you can cut to a wall, fence, or tree. The closer the cut, the less hand trimming you'll have to fuss with.

How is the cutter mounted? Cutters that are bolted rigidly to the frame of the mower follow the mower, not the ground. On uneven ground, the mower's wheels can bridge humps or gullies, causing the blade to scalp or skip in spots. In many riding mowers, the cutter housing rides on its own wheels or is flexibly suspended so that it follows the contours of the ground more closely.

All mowers have a means of raising and lowering the blade to vary cutting height, but this is done more easily in some than in others. On some machines, you can vary cutting height without even stopping. Others require the more or less permanent insertion of shaft spacers to establish blade height.

The engine. Most engines are of four-cycle design and are made by nationally known engine manufacturers. How much power you buy depends partly on your lot and partly on your personal taste. A three-hp. machine *will* cut grass, but not as efficiently, or as quickly, or as smoothly—or as glamorously—as a six-hp. machine. If you have a small, level lot, an economy model can be a good buy. But if you need hill-climbing power and go-anywhere ruggedness, better think bigger.

The drive. Most riding mowers use rear-wheel drive with the engine also in the rear. This puts both the engine and driver over the wheels for good traction. But you'll find other combinations, too. A few machines have the drive in the rear but the engine

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up front, and a couple have both engine and drive in the front.

Most makers agree on the use of a V-belt drive to the mower blades, but differ widely on the drive to the wheels. Some use chains only, arguing positive power delivery, while others use a combination of belts and chains. In some of the fancier machines, the wheels are powered by gears through a differential, as in a car. Chains and gears are desirable in heavy, high-powered machines where ruggedness is a must, but belts are economical and are adequate for small, lightweight models.

All but the cheapest machines have some kind of differential to let the driving wheels rotate independently so they can make smooth, tight turns without tearing up the lawn. In some machines, the differential can be locked against slippage when you want maximum power on both wheels. In a few models, the driving wheels can be disengaged completely by removing pins. This allows them to free-wheel so you can push the machine easily by hand.

How many speeds? A multispeed transmission gives you better control on slopes and around obstructions, but a lot of speeds may not be absolutely necessary. On a bare, level lot, you may be paying largely for the luxury of shifting speeds just for the fun of it.

One feature that is not a luxury, however, is a reverse speed. It's important to be able to back out of a narrow place—your garage, for example—where there's no room to turn around.

How about brakes? You'll get brakes on better machines, but not on economy models. Where brakes are specified, find out what kind. Some machines provide only a parking brake, while others have running brakes that go on automatically.

Other points to check on are seat comfort and steering ease. Most of today's mowers have stylishly upholstered seats, but you should try them yourself. The old-fashioned farm hay-rake seat shaped to fit your fanny is still likely to be more comfortable—even in bare steel—than one that's merely a thinly padded flat board.

You'll find a variety of steering styles to choose from: the simple tiller bar, handlebars, automotive-style round wheels, and aircraft-type half-round and oval wheels. Watch out for wheels that are too small to give good leverage. ■■

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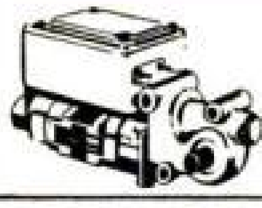

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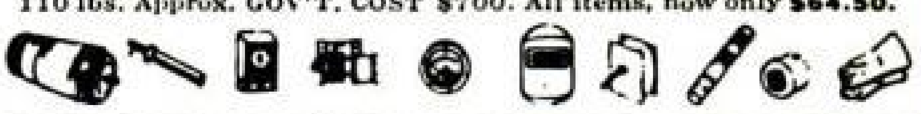

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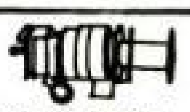

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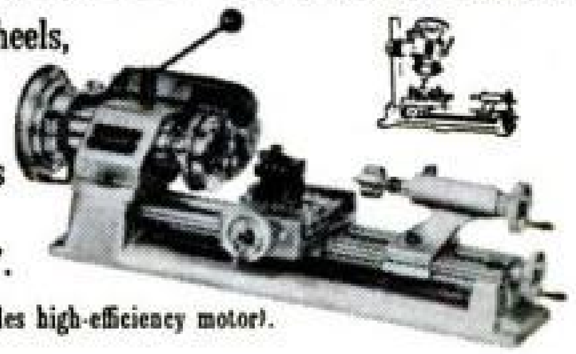

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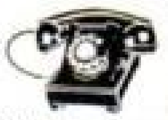

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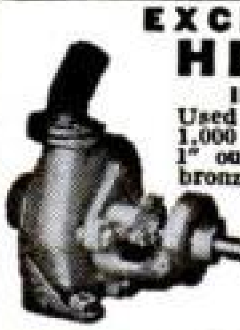

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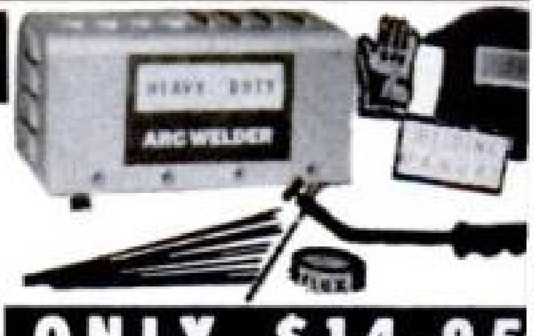

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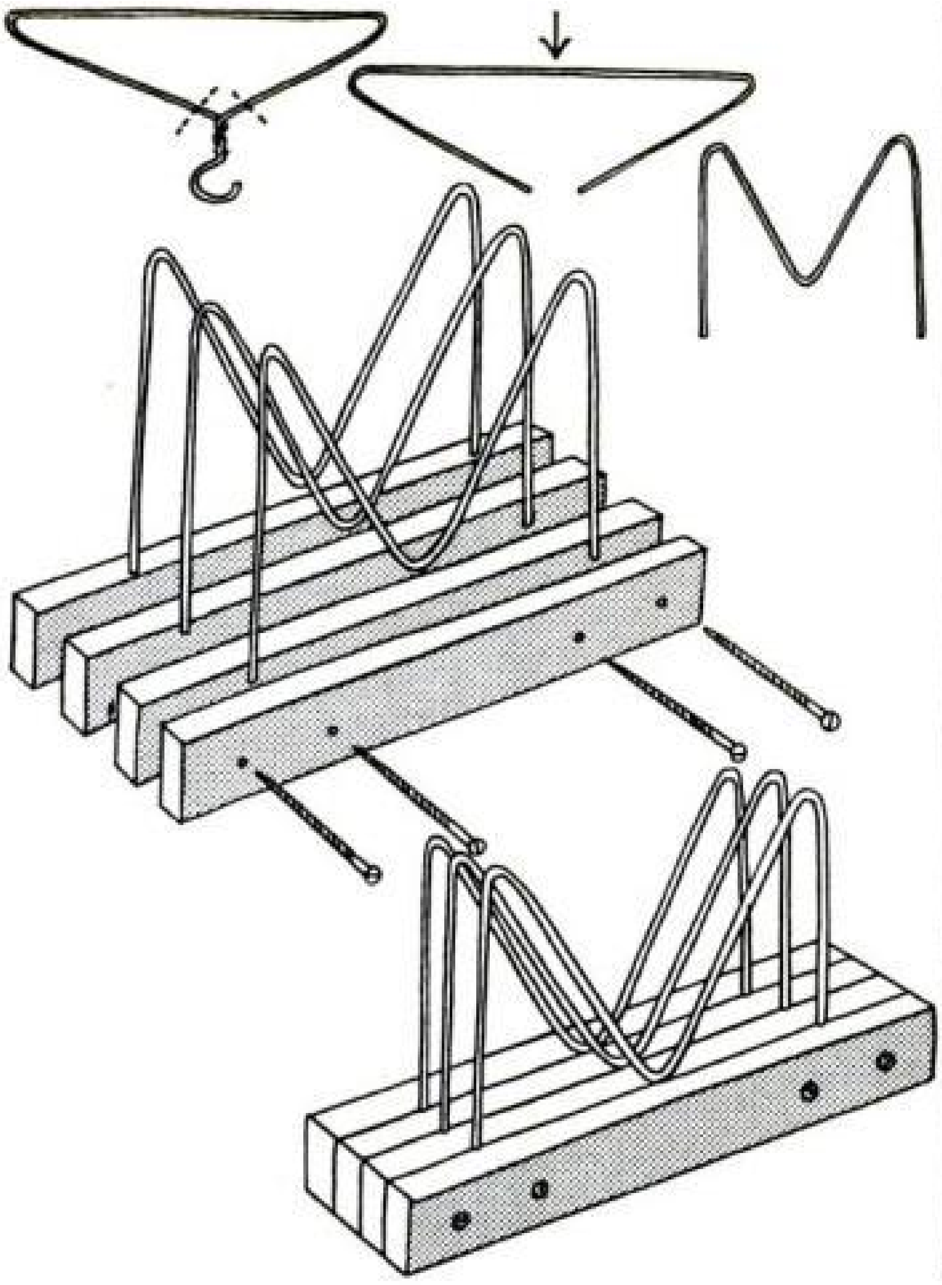

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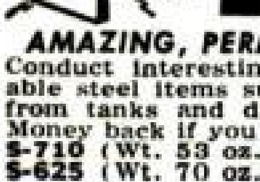

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[Continued from page 93]

ing with orchestra, and many different kinds of full orchestral sounds—were played during the tests.

The results. All judges agreed that the units fell naturally into five different groups, with Group 1 further subdivided into two categories. And the high overall quality of the instruments is shown by the fact that the majority fall into the two top groups listed below.

Group 1A: KLH, Shure, Sylvania. All of these units are very good. Differences between them tend to be small. Judges did, however, express slight preferences for those in Group 1A over those in Group 1B (below).

The KLH and Sylvania, the lowest priced (as well as smallest) of all Group 1 phonographs, were judged best buys. The Shure, however, with its larger speakers, has greater bass-handling capability, which shows up especially well in wall-shaking passages. The character of the Shure sound is also less bright than the KLH and Sylvania. (The KLH, incidentally, is available at all Singer Sewing Center stores under the brand name, Singer. The packaging is slightly different, but its performance is identical.)

Group 1B: Benjamin, Fisher 75, Scott. Differences between these units and those in group 1A are extremely small; with some types of music, judges expressed no preference. These models, however, were not chosen as consistently as the others. Some listeners may like them as well or better, or may want the special features on these models.

Group 2: Columbia, Electro-Voice, Fisher 50, Pilot. While all of these produced acceptable sound, they were consistently rated below those in the top group.

Group 3: Motorola, Philco. These units did not produce what most audio experts would identify as high-fidelity sound.

Group 4: Admiral. Close to the two above, but slightly less desirable. The Motorola, Philco, and Admiral, were the only units tested that supply a special spindle for playing 45-r.p.m. records as standard equipment. Such a spindle is available for all of the other phonographs in the test at extra cost.

Group 5: Lafayette. Low price of this unit is reflected in the somewhat lower overall sound quality. ■ ■

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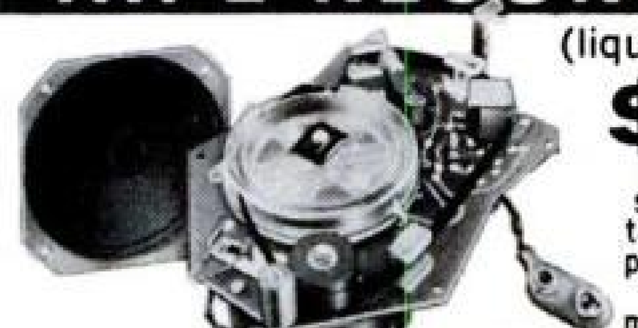

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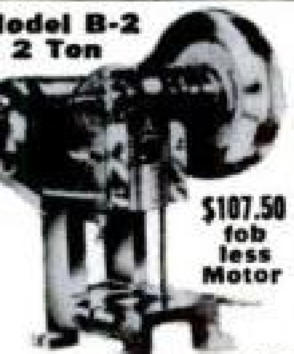

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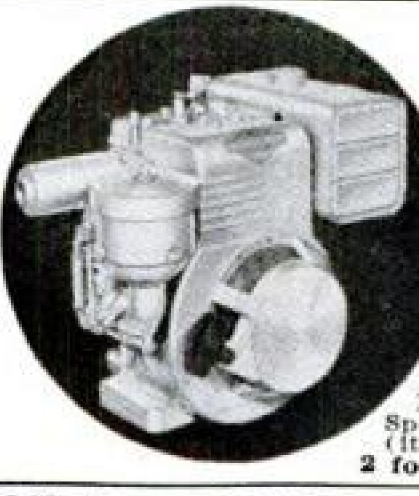

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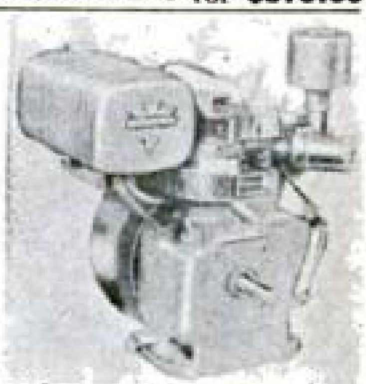

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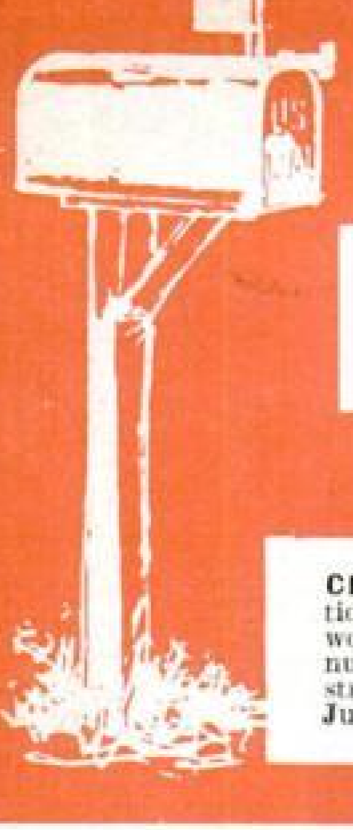

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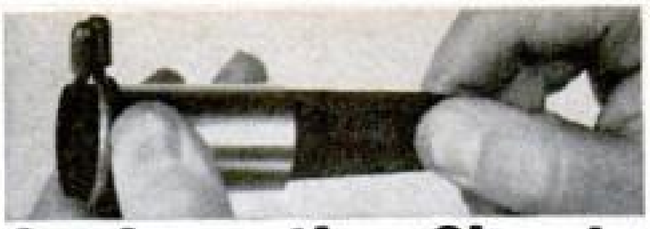

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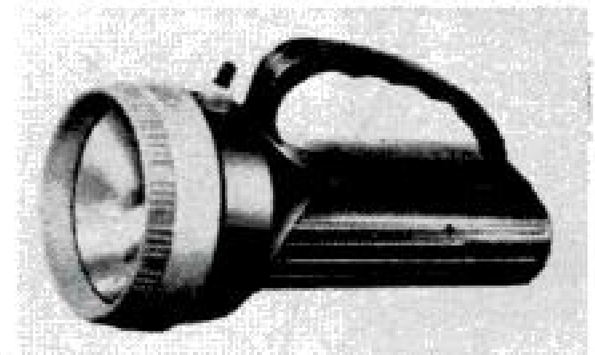

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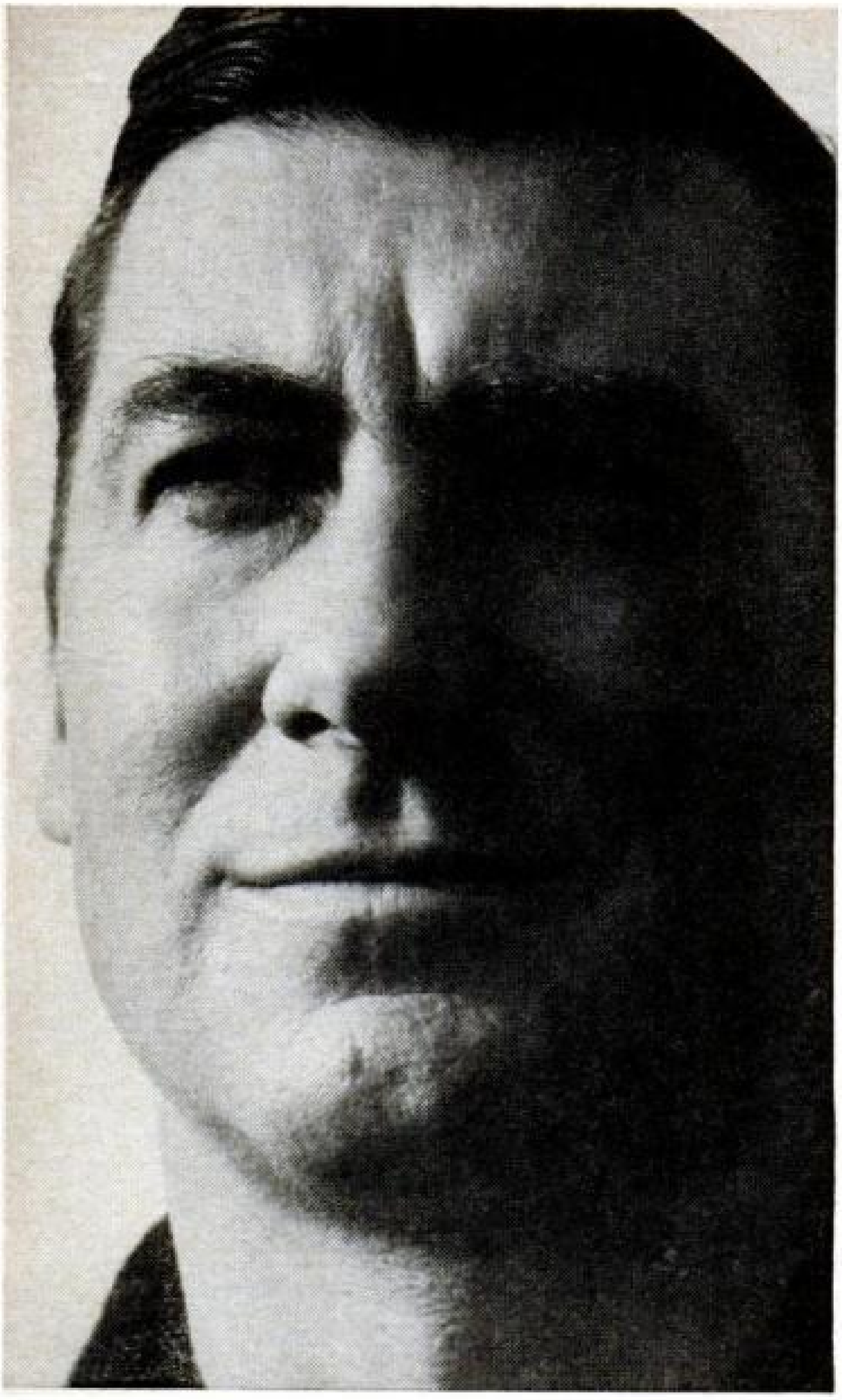

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